COSEWIC
Assessment and Status Report

on the

Caribou
Rangifer tarandus

Northern Mountain population
Central Mountain population
Southern Mountain population

in Canada

Northern Mountain population - SPECIAL CONCERN
Central Mountain population - ENDANGERED
Southern Mountain population - ENDANGERED
2014

COSEWIC
Committee on the Status
of Endangered Wildlife
in Canada

COSEPAC
Comité sur la situation
des espèces en péril
au Canada

COSEWIC status reports are working documents used in assigning the status of wildlife species suspected of being at risk. This report may be cited as follows:

COSEWIC. 2014. COSEWIC assessment and status report on the Caribou *Rangifer tarandus*, Northern Mountain population, Central Mountain population and Southern Mountain population in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xxii + 113 pp. (www.registrelep-sararegistry.gc.ca/default_e.cfm).

Previous report(s):

COSEWIC. 2002. COSEWIC assessment and update status report on the woodland caribou *Rangifer tarandus caribou* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xi + 98 pp. (Species at Risk Status Reports)

Thomas, D.C., and D.R. Gray. 2002. Update COSEWIC status report on the woodland caribou *Rangifer tarandus caribou* in Canada, *in* COSEWIC assessment and update status report on the Woodland Caribou *Rangifer tarandus caribou* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 1-98 pp.

Kelsall, J.P. 1984. COSEWIC status report on the woodland caribou *Rangifer tarandus caribou* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. 103 pp.

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Cover illustration/photo:
Caribou — Photo of a Caribou from the Central Mountain population, Kennedy Siding subpopulation. Photo credit: Dayn Craig (with permission).

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COSEWIC
Assessment Summary

Assessment Summary – May 2014

Common name
Caribou - Northern Mountain population

Scientific name
Rangifer tarandus

Status
Special Concern

Reason for designation
This population occurs in 45 subpopulations ranging from west-central British Columbia to the Yukon and western Northwest Territories. Almost all of its distribution is in Canada, where it numbers about 43,000 - 48,000 mature individuals. There is little long-term (three generations) trend information, and many current estimates are based on survey data more than 5 years old. Currently 2 subpopulations are thought to be increasing, 7 are stable and 9 are declining. The condition of the remaining 27 subpopulations is unknown. The two largest subpopulations comprise > 15,000 animals, or 26-29% of the estimated population, and are thought to be stable. About half of the 45 subpopulations each contain < 500 individuals. All stable or increasing subpopulations are located in the northern part of the range, whereas 9 in the southern part of the range have declined by 27% since the last assessment. The status of northern subpopulations may be compromised in the future because of increasing threats, particularly land use change with industrial development causing shifts in predator-prey dynamics.

Occurrence
Yukon, Northwest Territories, British Columbia

Status history
The Northern Mountain population was designated Not at Risk in May 2000. This population was formerly designated as part of the "Western population"(now de-activated). Status re-examined and designated Special Concern in May 2002. Following the Designatable Unit report on caribou (COSEWIC 2011), a new population structure was proposed and accepted by COSEWIC. This new Northern Mountain population is composed of all 36 subpopulations in the previous Northern Mountain population of Caribou in addition to 9 subpopulations from the previous (2002) Southern Mountain population. The Northern Mountain population was designated Special Concern in May 2014.

Assessment Summary – May 2014

Common name
Caribou - Central Mountain population

Scientific name
Rangifer tarandus

Status
Endangered

Reason for designation
This population is endemic to Canada and occurs in 10 extant subpopulations in east-central British Columbia and west-central Alberta in and around the Rocky Mountains. The current estimate for the population is 469 mature individuals and it has declined by at least 64% over the past 3 generations. One subpopulation in central British Columbia was confirmed extirpated in 2014, and an additional one in Banff in 2010. All extant subpopulations are estimated to contain fewer than 250 mature individuals, with 4 of these having fewer than 50. Two recognized subpopulations in 2002 have since split due to lack of dispersal within former ranges. All subpopulations have experienced declines of about 60% since the last assessment in 2002, and declines continue for all but one subpopulation, which has an unknown trend. Surveys have shown consistently high adult mortality and low calf recruitment, accelerating decline rates. Threats are continuing and escalating.

Occurrence
British Columbia, Alberta

Status history
Following the Designatable Unit report on caribou (COSEWIC 2011), a new population structure was proposed and accepted by COSEWIC. This resulted in the new Central Mountain population, composed of 12 subpopulations from the previous Southern Mountain population of Caribou (COSEWIC 2002). The Central Mountain population was designated Endangered in May 2014.

Assessment Summary – May 2014

Common name
Caribou - Southern Mountain population

Scientific name
Rangifer tarandus

Status
Endangered

Reason for designation
This population is largely restricted to Canada, except for < 40 animals in Idaho and Washington. It occurs in 15 extant subpopulations in southeastern British Columbia. Two subpopulations have been extirpated since 2002. The current estimate for the population is 1,356 mature individuals, which has declined by at least 45% in the past three generations, and 27% since the last assessment in 2002. All but two extant subpopulations are estimated to contain fewer than 250 mature individuals, with 9 of these having fewer than 50, and 6 with fewer than 15 mature individuals. Dispersal within the ranges of 11 subpopulations is severely limited. Surveys have shown consistently high adult mortality and low calf recruitment, accelerating decline rates. Threats are continuing and escalating.

Occurrence
British Columbia

Status history
The Southern Mountain population was designated Threatened in May 2000. This population was formerly designated as part of the "Western population" (now deactivated). Status re-examined and confirmed in May 2002. Following the Designatable Unit report on Caribou (COSEWIC 2011), a new population structure was proposed and accepted by COSEWIC. This resulted in the new Southern Mountain population, composed of 17 subpopulations from the former Southern Mountain population of Caribou (COSEWIC 2002). The remaining subpopulations were assigned to the new Central and Northern Mountain populations.The Southern Mountain population was designated Endangered in May 2014.

COSEWIC
Executive Summary

Caribou
Rangifer tarandus

Northern Mountain population
Central Mountain population
Southern Mountain population

Wildlife Species Description and Significance

All the world's caribou and reindeer belong to a single species, *Rangifer tarandus*, and are found in arctic and subarctic regions as well as in northern forests. Caribou that occur in the western mountainous region of Canada are largely brown in colour with a white mane. Mature females and males usually weigh 110-150 kg and 160-210 kg, respectively. Both males and females grow antlers, although some females may lack these. A distinctive characteristic is large, rounded hooves that reduce sinking in snow and wetlands and act as shovels when digging for food under snow.

Western mountain caribou have played an important role for Aboriginal peoples as well as for early fur traders and settlers. A majority of the current range is in Canada in the Northern Mountain, Central Mountain and Southern Mountain populations. Northern and Central Mountain Caribou both inhabit shallow snow areas in winter where they forage primarily for terrestrial lichens, but differ in their genetic makeup and evolutionary origin. Southern Mountain Caribou are distinct from other mountain caribou in that they have adapted to living in a deep snow environment where they forage primarily for arboreal lichens in winter.

Distribution

Northern Mountain Caribou are currently distributed across 45 subpopulations ranging from west-central British Columbia north to Yukon and Northwest Territories. The Central Mountain population includes 10 extant subpopulations in east-central BC and west-central Alberta in and around the Rocky Mountains. Southern Mountain Caribou are distributed across 15 extant subpopulations in the deep snow-belt region of southeastern BC, and northern Idaho and Washington in the United States. There has been an overall range loss in western mountain caribou of about 30% since the early 1900s, with the major change in distribution occurring in the central and southern portion of BC and Alberta.

Habitat

In general, caribou require large tracts of range where they can separate themselves (horizontally and altitudinally) from other prey and predators, and shift their range use in response to various natural processes (e.g. fire, forest insects, weather/snow conditions) and human activities (e.g. disturbance from forest harvesting, mining, oil and gas, and recreation). Access to high-quality undisturbed calving areas in high-elevation alpine, subalpine parkland, subalpine forests, and/or islands in lakes is also essential to mountain caribou survival. While some subpopulations or portions of subpopulations migrate long distances between winter and summer ranges, others do not.

In winter months, both Northern and Central Mountain Caribou forage primarily on terrestrial lichens either in older coniferous forests at low elevations or on windswept alpine slopes, and summer at high elevations in mountains. They also may forage on arboreal lichens in older low-elevation and subalpine forests. Southern Mountain Caribou spend the winter at higher elevations in older subalpine forests where they are able to walk on a hardened snowpack and eat arboreal lichens. Caribou habitat has declined in quality and extent on many ranges due to impacts from industrial activities, particularly in Alberta and British Columbia.

Biology

Mountain caribou breed in late September and October. Mountain caribou have only one calf per year and females do not generally breed until they are at least 2 years old. Although pregnancy rates are generally high (over 90%), calf survival during the first few months is often 50% or less. Pregnant females travel to isolated, relatively predator-free areas in the mountains to calve in mid-late May or early June. Calf survival is higher for females that calve at high elevations in mountainous terrain or on islands in lakes, compared to females that calve below treeline where they are closer to other ungulates and predators. Caribou are usually one of several prey species in multiple predator-prey systems. Wolves and bears are the main predators of caribou; however, cougars, wolverine, golden eagles, and other predators may also kill adults and/or calves in some areas or during some seasons. Although they have diverse diets, western mountain caribou are adapted to feed on lichens, with specialized microbes in their stomachs that digest and extract nutrients from lichens efficiently. They can withstand severe cold because their thick winter coat contains insulating semi-hollow hair.

Population Sizes and Trends

The current Northern Mountain Caribou population estimate is about 45 000 mature individuals; however, estimates for only 16 of 45 (36%) of the subpopulations are based on surveys conducted within the last 5 years. Twenty-six subpopulations consist of >500 caribou and 13 are <250. Current trends are known for 18 subpopulations: 9 decreasing, 7 stable, and 2 increasing; all 5 subpopulations in west-central BC are declining. Late winter calf recruitment was <15% for 6 of 10 subpopulations with sufficient data. An overall trend for caribou in the Northern Mountain DU is not possible to determine because survey data and/or data on vital rates for most subpopulations are lacking. The 9 subpopulations in the southern part of the range have declined by 27% since the last COSEWIC assessment in 2002.

The current Central Mountain DU caribou population is estimated at 469 mature individuals. The population has declined by at least 64% over the last 27 years (3 generations) and 62% over the last 18 years (2 generations). All 10 currently recognized extant subpopulations consist of <250 mature individuals; 4 of these are <50. All but one are in continued decline; the status of one is unknown. Two additional subpopulations have been confirmed extirpated since the last status report in 2002 and two recognized subpopulations in 2002 have since split into several due to lack of dispersal within some part of the ranges.

The current estimate for the Southern Mountain DU caribou population is 1,356 mature individuals. The population has declined by at least 45% over the last 27 years (3 generations), 40% over the last 18 years (2 generations), and 27% since the last assessment in 2002. All 15 extant subpopulations consist of <500 mature individuals, 13 of which are <250, and 9 <50; some former subpopulations have split into several due to lack of dispersal within ranges. Fourteen of 15 subpopulations have declined since the last status report in 2002. At present, 11 subpopulations are still declining, 3 are stable and 1 is increasing. Most subpopulations have been subjected to intensive management measures, including translocations, wolf sterilization programs, and moose reduction through liberalized hunting. Two additional subpopulations have been extirpated since 2002. A recent population viability analysis predicted that 13 of 15 subpopulations would be lost within 50 years.

Threats and Limiting Factors

In the Northern Mountain DU, major threats include altered predator-prey dynamics due to habitat change. Human disturbance and habitat loss (including functional habitat loss due to avoidance) have resulted from the cumulative effects of forest harvesting, mineral exploration and development and associated access, motorized and non-motorized recreational activities, changes in forest structure due to Mountain Pine Beetle infestations and/or associated salvage logging, and impacts from climate change.

The primary threats to caribou in the Central Mountain DU include altered predator-prey dynamics due to both direct and functional habitat loss and disturbance resulting from multiple industrial activities including forest harvesting, coal exploration and development, and oil and gas exploration and development. Additional factors include vehicle collisions, motorized recreation (all terrain vehicle, snowmobiling), facilitated access to caribou winter range for predators resulting from increased linear corridors and packed trails or ploughed roads in winter, impacts from climate change, and stochastic environmental events associated with small population sizes.

The primary threats to caribou in the Southern Mountain DU include altered predator/prey dynamics due to habitat change resulting from forest harvesting in adjacent low-elevation valley bottoms, snowmobiling, heli-skiing, impacts from climate change, and the severe limitation of small populations that will have a high likelihood of becoming extirpated due to random environmental and demographic events.

Protection, Status, and Ranks

Caribou in the former COSEWIC Southern Mountain population are currently listed as Threatened under the federal *Species at Risk Act*. This includes all caribou in the current Southern Mountain and Central Mountain DUs and 9 subpopulations in west-central and north-central BC in the Northern Mountain DU. Caribou in the former Northern Mountain population are listed as Special Concern under the federal *Species at Risk Act*. The majority of western mountain caribou habitat is on public land. Protected areas cover 22%, 41%, and 32% of the Northern Mountain, Central Mountain and Southern Mountain DU caribou ranges respectively, although most of the protected portion of the Central Mountain DU range covers high-elevation summer habitat. In addition to protected areas, in BC, Ungulate Winter Ranges and Wildlife Habitat Areas were established in 2009 to protect areas from forest harvesting or to guide forest harvesting activities.

TECHNICAL SUMMARY - Northern Mountain population

Rangifer tarandus
Caribou – Northern Mountain population Caribou – Population des montagnes du Nord
Range of occurrence in Canada (province/territory/ocean): British Columbia, Yukon, Northwest Territories

Demographic Information

Generation time *(calculated using IUCN formula)*	9 yrs
Is there an observed continuing decline in number of mature individuals? (*Trend is known for 18 of 45 subpopulations representing approximately 54% of the current population; 9 are declining, mostly in the southern portion of the DU (including all 5 west-central BC subpopulations), and 2 are known to be increasing; 6 of 10 subpopulations with ≥3 years of late winter recruitment data have calf recruitment <15%*)	Overall trend is unknown
Estimated percent of continuing decline in total number of mature individuals within 5 years or 2 generations (*See above*)	Overall trend is unknown
Estimated percent reduction in total number of mature individuals over the last 10 years, or 3 generations (*See above*)	Overall trend is unknown
Suspected percent reduction in total number of mature individuals over the next 10 years, or 3 generations. (*See above. Subpopulations that are declining will likely continue to decline. However, fluctuations in the number of caribou in large subpopulations in the northern portion of the DU or refined population estimates for those subpopulations could mask declines of smaller subpopulations when considering the total number of caribou in the DU*)	Overall trend is unknown
Suspected percent reduction in total number of mature individuals over any 10 years, or 3 generations period, over a time period including both the past and the future. (*See above*)	Overall trend is unknown
Are the causes of the decline clearly reversible and understood and ceased? (*Causes of decline known for 9 declining subpopulations, but declines are not ceased and are not clearly reversible*)	N/A Trend unknown for most of the 45 subpopulations
Are there extreme fluctuations in number of mature individuals?	No

Extent and Occupancy Information

Estimated extent of occurrence	1,050,174 km²
Index of area of occupancy (IAO)	523 672 km²
Is the population severely fragmented?	No
Number of locations* *(Diverse threats across range)*	N/A

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* See Definitions and Abbreviations on COSEWIC website and IUCN 2010 for more information on this term.

Is there an inferred continuing decline in extent of occurrence?	No
Is there an inferred continuing decline in index of area of occupancy? *(9 populations are known to be declining, leading to a reduction in density, but not total distribution)*	Not likely
Is there an observed continuing decline in number of populations? *(some subpopulations have declined to low levels but no subpopulations have yet been extirpated in this DU; as more information is collected on distribution and movements of subpopulations, further refinement of subpopulation boundaries may result in a recalibration of the number of subpopulations)*	No
Is there an inferred continuing decline in number of locations*?	N/A
Is there an inferred continuing decline in area, extent and/or quality of habitat? *(in the southern portion of the DU and in more accessible ranges in the northern portion of the DU, industrial and other human activities resulting in habitat change favouring other prey species, and/or disturbance to caribou are continuing)*	Yes
Are there extreme fluctuations in number of populations?	No
Are there extreme fluctuations in number of locations*?	N/A
Are there extreme fluctuations in extent of occurrence?	No
Are there extreme fluctuations in index of area of occupancy?	No

Number of Mature Individuals (in each of 45 extant subpopulations)

Subpopulation	N Mature Individuals
Hart River, YT	1853
Clear Creek,YT	801
Bonnet Plume, YT/NT	4200
Redstone, YT/NT	7300-10000
South Nahanni, YT/NT	1886
Coal River, YT/NT	413
La Biche, YT/NT	388
Chisana, YT	587
Kluane, YT	163
Aishihik, YT	1813
Klaza, YT	1065
Ethel Lake, YT	289
Moose Lake, YT	270
Tay River, YT	2907
Tatchun, YT	415
Pelly Herds, YT	876
Finlayson, YT	2657
Wolf Lake, YT	1240
Laberge, YT	176
Ibex, YT	748
Carcross, YT/BC	674
Atlin, YT/BC	514-857
Swan Lake, BC	515-686
Little Rancheria, YT/BC	672-1342

Horseranch, YT/BC	680-850
Level Kawdy, BC	1239
Edziza, BC	140
Tsenaglode, BC	85-340
Spatsizi, BC	2258
Liard Plateau, YT/BC	140
Rabbit, BC	1095
Muskwa, BC	828
Gataga, BC	220
Frog, BC	199
Finlay, BC	19
Pink Mountain, BC	1145
Graham, BC	637
Chase, BC	404
Wolverine, BC	298
Takla, BC	98
Telkwa, BC	19
Tweedsmuir, BC	248
Itcha-Ilgachuz, BC	1220
Rainbows, BC	43
Charlotte Alplands, BC	6
Total	**43,443 - 47,752**

Quantitative Analysis

Probability of extinction in the wild is at least 20% within 20 years or 5 generations, or 10% within 100 years. *(Population viability analyses [PVAs] are available for only 2 subpopulations, both in west-central BC. The PVA for the Tweedsmuir subpopulation predicts that the population will decrease by at least 50% in 20 years and the model for the Itcha-Ilgachuz PVA also predicts a decline)*	N/A

Threats (actual or imminent, to populations or habitats)

Altered predator-prey dynamics due to habitat change, human disturbance/habitat loss as a result of forest harvesting, mineral exploration and development and associated access, changes in habitat structure following Mountain Pine Beetle infestations and/or associated salvage logging, and motorized and non-motorized recreational activities.

Rescue Effect (immigration from outside Canada)

Status of outside population(s)? *Interior Alaska subpopulations have not been assessed with respect to COSEWIC designatable units*	Ranked as secure in Alaska, but many subpopulations are declining
Is immigration known or possible?	Yes
Would immigrants be adapted to survive in Canada?	Yes
Is there sufficient habitat for immigrants in Canada?	Yes, in the northern part of the DU
Is rescue from outside populations likely? *(Possibly from Alaska but the subpopulations there have not been assessed with respect to COSEWIC designatable units)*	Possibly from Alaska

Data-Sensitive Species

Is this a data-sensitive species?	No

COSEWIC Status History

The Northern Mountain population was designated Not at Risk in May 2000. This population was formerly designated as part of the "Western population"(now deactivated). Status re-examined and designated Special Concern in May 2002. Following the Designatable Unit report on Caribou (COSEWIC 2011), a new population structure was proposed and accepted by COSEWIC. This new Northern Mountain population is composed of all 36 subpopulations in the previous Northern Mountain population of Caribou in addition to 9 subpopulations from the previous (2002) Southern Mountain population. The Northern Mountain population was designated Special Concern in May 2014.

Status and Reasons for Designation:

Status: Special Concern	**Alpha-numeric code**: Not applicable

Reasons for designation:

This population occurs in 45 subpopulations ranging from west-central British Columbia to Yukon and western Northwest Territories. Almost all of its distribution is in Canada, where it numbers about 43,000 - 48,000 mature individuals. There is little long-term (three generations) trend information, and many current estimates are based on survey data more than 5 years old. Currently 2 subpopulations are thought to be increasing, 7 are stable and 9 are declining. The condition of the remaining 27 subpopulations is unknown. The two largest subpopulations comprise > 15,000 animals, or 26-29% of the estimated population, and are thought to be stable. About half of the 45 subpopulations each contain < 500 individuals. All stable or increasing subpopulations are located in the northern part of the range, whereas 9 in the southern part of the range have declined by 27% since the last assessment. The status of northern subpopulations may be compromised in the future because of increasing threats, particularly land use change with industrial development causing shifts in predator-prey dynamics.

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals):
Unknown. Evidence for declines in some subpopulations, but overall trend unknown.

Criterion B (Small Distribution Range and Decline or Fluctuation):
Not applicable. EO and IAO exceed thresholds.

Criterion C (Small and Declining Number of Mature Individuals):
Not applicable. Population exceeds 10,000 mature individuals.

Criterion D (Very Small or Restricted Population):
Not applicable. Population exceeds 1,000 mature individuals, and IAO and number of locations exceeds thresholds.

Criterion E (Quantitative Analysis):
Not applicable.

TECHNICAL SUMMARY - Central Mountain population

Rangifer tarandus
Caribou – Central Mountain population Caribou – Population des montagnes du Centre
Range of occurrence in Canada (province/territory/ocean): British Columbia, Alberta

Demographic Information

Generation time *(calculated using IUCN formula)*	9 yrs
Is there an observed continuing decline in number of mature individuals?	Yes
Estimated percent of continuing decline in total number of mature individuals within 5 years or 2 generations *(based on the rate of decline for the past 2 generations). The decline rate is likely an underestimate, as the early surveys on which the decline was based for some subpopulations was more recent than 2 generations ago)*	At least 62%
Estimated percent reduction in total number of mature individuals over the last 10 years or 3 generations. *(9 of 10 extant subpopulations are declining, one of which may be extirpated, and the trend for the other is unknown. Two additional subpopulations have been confirmed extirpated. The decline rate is likely an underestimate, as the early surveys on which the decline was based for some subpopulations was > 3 generations ago)*	At least 64%
Suspected percent reduction in total number of mature individuals over the next 10 years, or 3 generations. *(based on the rate of decline for the past 3 generations)*	At least 64%
Suspected percent reduction in total number of mature individuals over any 10 years, or 3 generations period, over a time period including both the past and the future. *(based on the rate of decline for the past 3 generations)*	At least 64%
Are the causes of the decline clearly reversible and understood and ceased? *(Although the cause of the decline for most subpopulations has been attributed to altered predator-prey dynamics due to extensive habitat change from industrial activities, there may be additional contributing factors that are not well-understood; recovery of habitat will take decades and industrial activities are continuing and expanding. Subpopulations with lower levels of disturbance are also declining. Habitat destruction from industrial activities is ongoing and becoming more widespread).*	Reversible: Unknown; Understood: Incomplete; Ceased: No
Are there extreme fluctuations in number of mature individuals? *Does not meet IUCN definition of extreme fluctuations*	No

Extent and Occupancy Information

Estimated extent of occurrence	85,986 km²
Index of area of occupancy (IAO)	46 144 km²
Is the population severely fragmented?	Yes
Number of locations[*] *(diverse threats across range)*	N/A
Is there an inferred continuing decline in extent of occurrence? *(2 subpopulations have been extirpated since the previous status report in 2002 and the Bearhole/Redwillow portion of the Narraway subpopulation is considered to no longer occur in Alberta. EO cannot be directly compared with that of previous assessment due to change in DU boundaries)*	Likely
Is there an inferred continuing decline in index of area of occupancy? *(2 subpopulations have been extirpated since the previous status report in 2002. IAO cannot be directly compared with that of previous assessment due to change in DU boundaries)*	Likely
Is there an observed continuing decline in number of populations? *(2 subpopulations have been extirpated since the previous status report in 2002)*	Yes
Is there an inferred continuing decline in number of locations*?	N/A
Is there an inferred continuing decline in area, extent and/or quality of habitat? *(industrial and other human activities resulting in habitat change favouring other prey species, and/or disturbance to caribou is continuing; a recent analysis of habitat change for east-central BC subpopulations reported loss of very high and high quality winter habitat from 0 to 66% [Williamson-Ehlers et al. 2013]).*	Yes
Are there extreme fluctuations in number of populations?	No
Are there extreme fluctuations in number of locations*?	N/A
Are there extreme fluctuations in extent of occurrence?	No
Are there extreme fluctuations in index of area of occupancy?	No

Number of Mature Individuals (in each of 10 extant subpopulations)

Subpopulation	**N Mature Individuals**
Scott, BC	35
Moberly, BC	18
Kennedy Siding, BC	29
Quintette, BC	87
Narraway, BC/AB	78
Redrock-Prairie Creek, AB/BC	106
A La Peche, AB	75
Tonquin (Jasper), AB	30
Maligne (Jasper), AB	5
Brazeau (Jasper), AB	6
TOTAL	**469**

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[*] See Definitions and Abbreviations on COSEWIC website and IUCN 2010 for more information on this term.

Quantitative Analysis

Probability of extinction in the wild is at least [20% within 20 years or 5 generations, or 10% within 100 years]. *(PVAs were conducted on 10 subpopulations in three studies, but probability of extinction was not calculated for all)*	N/A

Threats (actual or imminent, to populations or habitats)

Altered predator-prey dynamics due to habitat change resulting from forest harvesting and forest harvesting in combination with oil and gas exploration and development; human disturbance and other habitat loss due to multiple industrial activities including forest harvesting, coal exploration and development, and oil and gas exploration and development. Other factors include vehicle collisions, motorized recreation (ATV, snowmobiling), facilitated access for predators, small population effects, and infectious diseases that are likely to have increasing negative impacts in a changing climate.

Rescue Effect (immigration from outside Canada)

Status of outside population(s)? *Endemic to Canada*	N/A
Is immigration known or possible?	No
Would immigrants be adapted to survive in Canada?	N/A
Is there sufficient habitat for immigrants in Canada?	N/A
Is rescue from outside populations likely?	No

Data-Sensitive Species

Is this a data-sensitive species?	No

COSEWIC Status History

Following the Designatable Unit report on caribou (COSEWIC 2011), a new population structure was proposed and accepted by COSEWIC. This resulted in the new Central Mountain population, composed of 12 subpopulations from the previous Southern Mountain population of Caribou (COSEWIC 2002). The Central Mountain population was designated Endangered in May 2014.

Status and Reasons for Designation:

Recommended Status: Endangered	**Alpha-numeric code**: A2a+3a+4a; C1+C2a(i)

Reasons for designation:

This population is endemic to Canada and occurs in 10 extant subpopulations in east-central British Columbia and west-central Alberta in and around the Rocky Mountains. The current estimate for the population is 469 mature individuals and it has declined by at least 64% over the past 3 generations. One subpopulation in central British Columbia was confirmed extirpated in 2014, and an additional one in Banff in 2010. All extant subpopulations are estimated to contain fewer than 250 mature individuals, with 4 of these having fewer than 50. Two recognized subpopulations in 2002 have since split due to lack of dispersal within former ranges. All subpopulations have experienced declines of about 60% since the last assessment in 2002, and declines continue for all but one subpopulation, which has an unknown trend. Surveys have shown consistently high adult mortality and low calf recruitment, accelerating decline rates. Threats are continuing and escalating.

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals):
Meets EN A2a+3a+4a.
Meets Endangered A2a with overall decline (at least 64%) exceeding 50%. Causes have not ceased and may not be reversible. Trend calculated based on a) direct observation. Meets Endangered A3a due to inferred reduction of greater than 50% in the next 3 generations based on ongoing decline trends. Trend calculated based on a) direct observation. Meets Endangered A4a due to suspected inferred reduction of greater than 50% based on impact within a 3-generation period in the past or into the future. Trend calculated based on a) direct observation. A1 is not applicable because the causes of the decline have not ceased.

Criterion B (Small Distribution Range and Decline or Fluctuation):
Not applicable. EO and IAO both exceed thresholds.

Criterion C (Small and Declining Number of Mature Individuals):
Meets Endangered C1+2a(i). Meets Endangered C1 as population numbers fewer than 2,500 and is experiencing an estimated continuing 2-generation decline of greater than 62% (exceeds 20% threshold). Meets Endangered C2a(i) as there is a continuing decline in number of mature individuals and no subpopulation is estimated to contain more than 250 individuals.

Criterion D (Very Small or Restricted Population):
Meets Threatened D1 as population fewer than 1,000 mature individuals. D2 is not applicable as IAO and the number of locations exceed thresholds.

Criterion E (Quantitative Analysis):
Not applicable. Three PVAs were conducted on most subpopulations but probability of extinction was not predicted for all.

TECHNICAL SUMMARY - Southern Mountain population

Rangifer tarandus
Caribou – Southern Mountain population Caribou – Population des montagnes du Sud
Range of occurrence in Canada (province/territory/ocean): British Columbia

Demographic Information

Generation time *(calculated using IUCN formula)*	9 yrs
Is there an observed continuing decline in number of mature individuals?	Yes
Estimated percent of continuing decline in total number of mature individuals within 5 years or 2 generations *(based on the rate of decline for the past 2 generations. The decline rate may be underestimated as the early survey upon which the decline was based for some subpopulations was more recent than 2 generations ago)*	At least 40%
Estimated percent reduction in total number of mature individuals over the last 10 years or 3 generations *(14/15 subpopulations have declined over the last 3 generations, and 2 have been extirpated. Only 1 is known to be increasing and that subpopulation currently consists of only 78 mature individuals. The decline rate may be underestimated as the early survey upon which the decline was based for some subpopulations was more recent than 3 generations ago)*	At least 45%
Suspected percent reduction in total number of mature individuals over the next 10 years, or 3 generations. *(based on the rate of decline for the past 3 generations)*	At least 45%
Suspected percent reduction in total number of mature individuals over any 10 years, or 3 generations period, over a time period including both the past and the future. *(based on the rate of decline for the past 3 generations)*	At least 45%
Are the causes of the decline clearly reversible and understood and ceased? *(Although the cause of the decline has been attributed to altered predator-prey dynamics due to habitat change resulting from forest harvesting in adjacent valley bottoms, there may be additional contributing factors that are not well-understood; recovery of habitat will take decades and industrial activities are continuing and expanding)*	Reversible: Unknown Understood: Incomplete Ceased: No
Are there extreme fluctuations in number of mature individuals?	No

Extent and Occupancy Information

Estimated extent of occurrence	118,240 km²
Index of area of occupancy (IAO)	46 324 km²
Is the population severely fragmented?	No

Number of locations* *(diverse threats across range)*	N/A
Is there an inferred continuing decline in extent of occurrence? *(2 subpopulations have been extirpated since the previous status report in 2002; EO cannot be directly compared with that of previous assessment due to change in DU boundaries)*	Yes
Is there an inferred continuing decline in index of area of occupancy? *(2 subpopulations have been extirpated since the previous status report in 2002. IAO cannot be directly compared with that of previous assessment due to change in DU boundaries)*	Yes
Is there an observed continuing decline in number of populations? *(2 subpopulations have been extirpated since the previous status report in 2002)*	Yes
Is there an inferred continuing decline in number of locations*?	N/A
Is there an inferred continuing decline in area, extent and/or quality of habitat?	Yes
Are there extreme fluctuations in number of populations?	No
Are there extreme fluctuations in number of locations*?	N/A
Are there extreme fluctuations in extent of occurrence?	No
Are there extreme fluctuations in index of area of occupancy?	No

Number of Mature Individuals (in each of 15 extant subpopulations)

Subpopulation	**N Mature Individuals**
South Selkirks	20
Purcells South	22
Nakusp	54
Duncan	2
Central Rockies	4
Monashee	4
Frisby Boulder	12
Columbia South	6
Columbia North	157
Groundhog	11
Wells Gray	341
Barkerville	78
North Cariboo Mountains	202
Narrow Lake	45
Hart Ranges	398
Total	**1,356**

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* See Definitions and Abbreviations on COSEWIC website and IUCN 2010 for more information on this term.

Quantitative Analysis

Probability of extinction in the wild is at least [20% within 20 years or 5 generations, or 10% within 100 years]. *(2 PVAs have been conducted on subpopulations within the Southern Mountain DU: one was based on vital rates [Wittmer et al. 2010], and one on population estimates from surveys [Hatter 2006]. Wittmer et al. [2010] found that 8/10 had probabilities >20% within 45 yrs (5 generations) and Hatter [2006] predicted quasi-extinction [<20 animals] in 20 years was >20% for 13 of 15 subpopulations)*	Yes

Threats (actual or imminent, to populations or habitats)

Altered predator/prey dynamics due to habitat change resulting from forest harvesting in adjacent low elevation valley bottoms, and from increased predator efficiency using trails created by snowmobiling and heli-skiing. Infectious diseases are likely to cause increasing negative impacts, particularly in a changing climate.

Rescue Effect (immigration from outside Canada)

Status of outside population(s)?	Endangered in Idaho and Washington
Is immigration known or possible?	No
Would immigrants be adapted to survive in Canada?	Possibly
Is there sufficient habitat for immigrants in Canada?	N/A
Is rescue from outside populations likely?	No

Data-Sensitive Species

Is this a data-sensitive species?	No

COSEWIC Status History

The Southern Mountain population was designated Threatened in May 2000. This population was formerly designated as part of the "Western population" (now deactivated). Status re-examined and confirmed in May 2002. Following the Designatable Unit report on Caribou (COSEWIC 2011), a new population structure was proposed and accepted by COSEWIC. This resulted in the new Southern Mountain population, composed of 17 subpopulations from the former Southern Mountain population (COSEWIC 2002). The remaining subpopulations were assigned to the new Central and Northern Mountain populations.The Southern Mountain population was designated Endangered in May 2014.

Status and Reasons for Designation:

Status: Endangered	**Alpha-numeric code**: A3a+4a; C1
Reasons for designation: This population is largely restricted to Canada, except for < 40 animals in Idaho and Washington. It occurs in 15 extant subpopulations in southeastern British Columbia. Two subpopulations have been extirpated since 2002. The current estimate for the population is 1,356 mature individuals, which has declined by at least 45% in the past three generations, and 27% since the last assessment in 2002. All but two extant subpopulations are estimated to contain fewer than 250 mature individuals, with 9 of these having fewer than 50, and 6 with fewer than 15 mature individuals. Dispersal within the ranges of 11 subpopulations is severely limited. Surveys have shown consistently high adult mortality and low calf recruitment, accelerating decline rates. Threats are continuing and escalating.	

Applicability of Criteria

Criterion A (Decline in Total Number of Mature Individuals): Meets Endangered A3a based on inferred reduction of >50% in the next 3 generations based on ongoing decline trends. Trend calculated based on a) direct observation. Meets Endangered A4a based on suspected inferred reduction of >50% based on impact within a 3-generation period in the past or into the future. Trend calculated based on a) direct observation. Meets Threatened A2a with overall decline (at least 45%) exceeding 30%. Causes have not ceased and may not be reversible. Trend calculated based on a) direct observation. A1 is not applicable as causes of decline have not ceased.
Criterion B (Small Distribution Range and Decline or Fluctuation): Not applicable. EO and IAO both exceed thresholds.
Criterion C (Small and Declining Number of Mature Individuals): Meets Endangered C1 as population contains < 2,500 mature individuals and shows a 2-generation decline of >40% (exceeds 20% threshold). Meets Threatened C2a(i). There is a continuing decline and all subpopulations estimated to contain < 1000 mature individuals (all but two < 250, almost meeting Endangered).
Criterion D (Very Small or Restricted Population): D1 is not applicable. Population > 1,000 individuals. D2 is not applicable. IAO and # locations exceed thresholds.
Criterion E (Quantitative Analysis): Meets Endangered E. Two PVAs conducted on 10/15 and 15/15 extant subpopulations respectively, predicted extinction risk > 20% in approximately 45 years (5 generations) for 13.

PREFACE

This report is based on information collected since the 2002 COSEWIC assessment and status report on the Woodland Caribou *Rangifer tarandus caribou* in Canada (COSEWIC 2002), and the report on Designatable Units for Caribou in Canada (COSEWIC 2011). Western mountain caribou (and the subject of this report) were first assessed as part of the "Western Population" in 1984 (Kelsall 1984). This unit was then split into the "Northern Mountain" and "Southern Mountain" populations in 2000, and assessed as Not at Risk and Threatened, respectively, but with no accompanying status report. The statuses of both populations were re-examined in May 2002 as two of four "ecotypes" of the Woodland Caribou subspecies (*Rangifer tarandus caribou*) considered in a larger report (COSEWIC 2002) that also included the "distinct population" of Newfoundland caribou. These mountain caribou ecotypes (Northern Mountain and Southern Mountain) were based on COSEWIC's National Ecological Areas of the same name. At that time, the Southern Mountain population was reaffirmed as Threatened, and Northern Mountain population was assessed as Special Concern.

This assessment follows an analysis of designatable unit structure of caribou in Canada undertaken by COSEWIC as a special project (COSEWIC 2011) to define the DUs for future status assessments and reassessments of this species according to the latest guidelines. Although prevailing taxonomy (Banfield 1961) recognizes four native extant and one extinct subspecies in North America (including Woodland Caribou, *Rangifer tarandus caribou*), it is outdated and does not capture the variability of caribou across their range in Canada. Based on the COSEWIC DU criteria for discreteness and significance (COSEWIC 2013), western mountain caribou were separated into three DUs: Northern Mountain caribou of BC, Yukon and NT (DU7), Central Mountain caribou of central BC and Alberta (DU8), and Southern Mountain caribou of southern BC (DU9) (COSEWIC 2011).

Much new research has been conducted on western mountain caribou since the last report, including new population survey information. Two subpopulations in the Southern Mountain DU and 2 in the Central Mountain DU have been confirmed as extirpated since the last assessment. This report also includes updates from traditional ecological knowledge collected and summarized from First Nations and Métis sources by the COSEWIC Aboriginal Traditional Knowledge (ATK) Subcommittee. These sources have been compiled and assessed in two reports: the Caribou ATK Source Report and the Caribou ATK Assessment Report.

COSEWIC HISTORY

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was created in 1977 as a result of a recommendation at the Federal-Provincial Wildlife Conference held in 1976. It arose from the need for a single, official, scientifically sound, national listing of wildlife species at risk. In 1978, COSEWIC designated its first species and produced its first list of Canadian species at risk. Species designated at meetings of the full committee are added to the list. On June 5, 2003, the *Species at Risk Act* (SARA) was proclaimed. SARA establishes COSEWIC as an advisory body ensuring that species will continue to be assessed under a rigorous and independent scientific process.

COSEWIC MANDATE

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) assesses the national status of wild species, subspecies, varieties, or other designatable units that are considered to be at risk in Canada. Designations are made on native species for the following taxonomic groups: mammals, birds, reptiles, amphibians, fishes, arthropods, molluscs, vascular plants, mosses, and lichens.

COSEWIC MEMBERSHIP

COSEWIC comprises members from each provincial and territorial government wildlife agency, four federal entities (Canadian Wildlife Service, Parks Canada Agency, Department of Fisheries and Oceans, and the Federal Biodiversity Information Partnership, chaired by the Canadian Museum of Nature), three non-government science members and the co-chairs of the species specialist subcommittees and the Aboriginal Traditional Knowledge subcommittee. The Committee meets to consider status reports on candidate species.

DEFINITIONS
(2014)

Wildlife Species	A species, subspecies, variety, or geographically or genetically distinct population of animal, plant or other organism, other than a bacterium or virus, that is wild by nature and is either native to Canada or has extended its range into Canada without human intervention and has been present in Canada for at least 50 years.
Extinct (X)	A wildlife species that no longer exists.
Extirpated (XT)	A wildlife species no longer existing in the wild in Canada, but occurring elsewhere.
Endangered (E)	A wildlife species facing imminent extirpation or extinction.
Threatened (T)	A wildlife species likely to become endangered if limiting factors are not reversed.
Special Concern (SC)*	A wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats.
Not at Risk (NAR)**	A wildlife species that has been evaluated and found to be not at risk of extinction given the current circumstances.
Data Deficient (DD)***	A category that applies when the available information is insufficient (a) to resolve a species' eligibility for assessment or (b) to permit an assessment of the species' risk of extinction.

* Formerly described as "Vulnerable" from 1990 to 1999, or "Rare" prior to 1990.

** Formerly described as "Not In Any Category", or "No Designation Required."

*** Formerly described as "Indeterminate" from 1994 to 1999 or "ISIBD" (insufficient scientific information on which to base a designation) prior to 1994. Definition of the (DD) category revised in 2006.

Environment Canada
Canadian Wildlife Service

Environnement Canada
Service canadien de la faune

Canada

The Canadian Wildlife Service, Environment Canada, provides full administrative and financial support to the COSEWIC Secretariat.

COSEWIC Status Report

on the

Caribou
Rangifer tarandus

Northern Mountain population
Central Mountain population
Southern Mountain population

in Canada

2014

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WILDLIFE SPECIES DESCRIPTION AND SIGNIFICANCE

Name and Classification

Class: Mammalia; Order: Artiodactyla; Family: Cervidae; Subfamily: Capreolinae

Scientific name: *Rangifer tarandus* Linnaeus 1758

Common names: Caribou, Woodland Caribou (English); Caribou, Caribou des bois (French); Wah stzee (Dunne-za); Whudzih or wudzįįh (Tsek'ene/Tse Keh Nay/Sakani); Kwun Ba Whut'en (Carrier Sekani); Vadzaih (Gwichin); Ekwe (North Slavey); T'onzi/Tohzi/T'ondzi (North Slavey – woodland caribou); Nodĺe (South Slavey - mountain caribou); Medzĺh (South Slavey - woodland caribou).

All caribou and reindeer in the world belong to one species, *Rangifer tarandus*. In Canada, Banfield (1961) classified caribou into four extant subspecies and one extinct subspecies based primarily on skull measurements and pelage, but also on antler shape and hoof shape. The four extant subspecies included "woodland caribou" (*R.t. caribou*), "barren-ground caribou" (*R.t. groenlandicus*), "Grant's caribou" (*R.t. granti*) and "Peary caribou" (*R.t. pearyi*). "Dawson's caribou" (*R.t. dawsoni*) were found on Haida Gwaii off the coast of BC before their extinction sometime during the early 1900s (Spalding 2000). Banfield's (1961) subspecies classification is still the most commonly used taxonomy, largely because no alternative has been identified in a systematic way or has ever been broadly accepted. Caribou in western mountain regions of North America are included in Banfield's (1961) "woodland" subspecies but have also been further categorized into ecotypes based on ecological conditions and adaptations. Ecotype names differ between jurisdictions, which leads to some confusion (see COSEWIC 2011). For example, in BC, caribou that live in areas of relatively shallow snowpacks and feed primarily on terrestrial lichens are called 'northern' ecotype caribou, while caribou that live in deep snow areas and feed primarily on arboreal lichens are 'mountain' ecotype caribou (Stevenson and Hatler 1985, Heard and Vagt 1998). In Alberta, caribou that feed primarily on terrestrial lichens and spend at least part of their annual cycle in the mountains are similar to BC's 'northern' ecotype but are called 'mountain' caribou (ASRD&ACA 2010). There is wide recognition that a complete revision of the taxonomic entities within *Rangifer* is needed (COSEWIC 2011).

Controversy surrounding Banfield's subspecies classification has been particularly pronounced for Woodland Caribou (*R. t. caribou*), because this includes caribou that occur in almost every available habitat type, despite exhibiting considerable variability in behaviour, ecology, and morphology (Geist 2007). To avoid problems associated with subspecies classification of caribou, the term "forest-dwelling caribou" will be used in this report to refer to caribou in Canada that remain south of treeline all year; "western mountain caribou" will be the collective term for caribou residing in the western mountains of North America. In addition, the term "population" will refer to caribou at the designatable unit (DU) level and "subpopulation" will be used when referring to individual herds.

Morphological Description

Caribou are mixed dark and lighter brown with a whitish mane and some white on their sides (Figure 1). Mature females and males usually weigh 110-150 kg and 160-210 kg, respectively, and height at the shoulder is 1.0-1.2 m. Some characteristics suggest that *Rangifer* is an ancient member of the family Cervidae (Banfield 1974). Both sexes can bear antlers although some females may lack antlers or have only one antler. A distinctive characteristic is large, rounded hooves that reduce sinking in snow and wetlands and act as shovels when digging for food under snow. The dew claws are large, widely spaced, and set back on the foot, which greatly increases weight-bearing area and reduces foot loads. Banfield (1961, 1974), Miller (1982), Kelsall (1984), Geist (1991), and Bergerud (2000) described physical features of caribou.

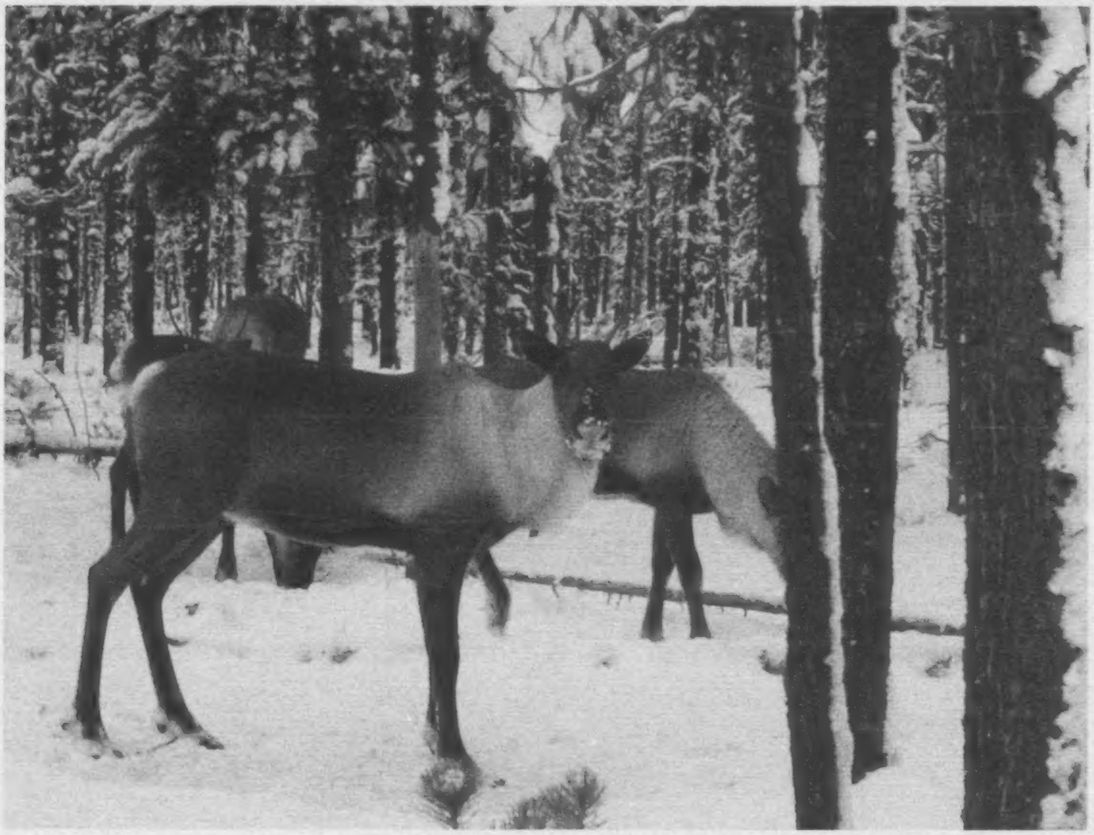


Figure 1. Photo of Central Mountain caribou, Kennedy Siding subpopulation, courtesy of Elena Jones.

From an Aboriginal traditional knowledge (ATK) perspective, "The participants described woodland caribou as being smaller in size than mountain woodland caribou and larger in size than the barren-ground caribou. The elders said that long ago, 'They did not call the caribou either mountain woodland or boreal woodland.' 'They just knew they were different in their markings, colour and hoof prints.' (Tulita elder)" (Sahtu Renewable Resources Board 2010).

Population Spatial Structure and Variability

Phylogenetic analyses of caribou based on mitochondrial DNA (mtDNA) studies provide information on genetic lineages, and studies of microsatellites on nuclear DNA provide information on genetic diversity and population structuring of forest-dwelling caribou. Available information focuses on caribou in west-central Alberta and east-central BC (Dueck 1998, McDevitt *et al.* 2009, Serrouya *et al.* 2012, Klütsch *et al.* 2012, Weckworth *et al.* 2012, Yannic *et al.* 2013), caribou in southeastern BC (Dueck 1998, Zittlau 2004, Serrouya *et al.* 2012) and caribou in Yukon and NT (Dueck 1998, Zittlau 2004, Kuhn *et al.* 2010, Weckworth *et al.* 2012), with limited information on caribou in northern and west-central BC (Zittlau 2004, Serrouya *et al.* 2012). In many studies, comparisons are made with subpopulations in other caribou DUs (COSEWIC 2011). Recent studies have contributed substantially to the understanding of phylogenetic and genetic structure of caribou in the western mountainous region of Canada, but further work is required to fill information gaps, especially for caribou in northern and west-central BC.

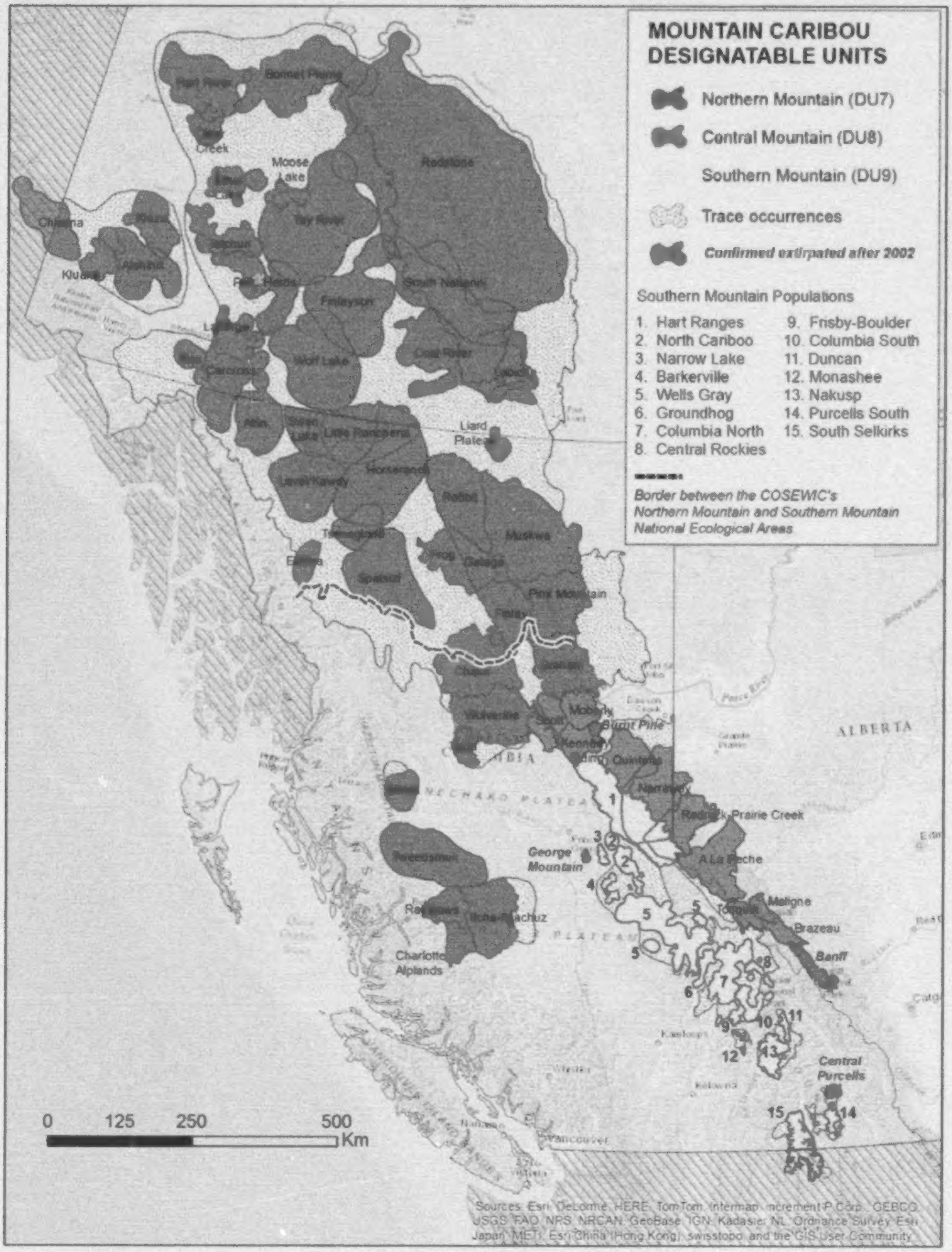
Phylogenetics

Phylogenetic analysis of caribou has revealed two distinct major haplogroups or clades, which suggest the isolation of caribou into two or three separate glacial refugia (Røed *et al.* 1991; Dueck 1998; McDevitt *et al.* 2009, COSEWIC 2011, Klütsch *et al.* 2012, Yannic *et al.* 2013). Dueck's (1998) study of mtDNA suggested that all caribou in Canada originated from northern and southern clades (groups) isolated about 49 000 years ago during the Wisconsinan glaciation. Glacial advances occurred in the Canadian Rockies 75,000-64,000 and 20,000-11,000 years ago (Gadd 1986). Two groups of caribou were separated between those early and late Wisconsinan episodes and distinct clades evolved in isolation. After the retreat of the large continental glaciera, the two groups spread out across Canada and their distributions overlapped. Klütsch *et al.* (2012) suggested that three lineages of forest-dwelling caribou in Canada may have originated from three geographically separate refugia south of the Laurentide ice sheet: one in the Appalachians, one in the Wisconsin area, and one in the Rocky Mountains, with the caribou from the Rocky Mountain refugium spreading into the western mountainous region in Canada. Yannic *et al.* (2013) found that two phylogeographic lineages have remained genetically homogenous since diverging two interglacial-glacial cycles ago, and secondary contact between them occurred in central Canada about 8,000 years BP.

Caribou phylogeographical structure appears to be chiefly the result of postglacial expansions after the last glacial maximum, which is corroborated by evidence from the fossil record, ecological considerations, and physiogeography (Klütsch *et al.* 2012, Yannic *et al.* 2013). Many of the subpopulations situated in both west-central Alberta/east-central BC and southeastern BC contain haplotypes from both northern and southern clades (Dueck 1998, McDevitt *et al.* 2009, Yannic *et al.* 2013), indicating possible contact zones. The greatest mix of haplotypes is in the eastern mountains of BC and adjacent Alberta where 0-56% of haplotypes in analyzed samples in east-central BC/west-central Alberta and 1-67% of haplotypes in analyzed samples in southeastern BC are from the northern clade. McDevitt *et al.* (2009) found a positive association between migratory behaviour of individual caribou and belonging to membership in the northern clade (i.e. individual caribou that migrated were more likely to belong to the northern clade). Present-day forest-dwelling caribou apparently have evolved from both clades and introgression of DNA occurred where the two clades met and overlapped in distribution.

Genetic population structure

Microsatellite data paint a complex picture of genetic population structuring within and among caribou subpopulations in western Canada. Studies were inconsistent in that they each assessed a unique combination of subpopulations, and in terms of the character of loci being used, making it difficult to compare some of the differing results among studies. Figure 2 displays the geography of subpopulations referred to below (see also **Designatable Units**).


MOUNTAIN CARIBOU DESIGNATABLE UNITS
Northern Mountain (DU7)
Central Mountain (DU8)
Southern Mountain (DU9)
Trace occurrences
Confirmed extirpated after 2002
Southern Mountain Populations
1. Hart Ranges
2. North Cariboo
3. Narrow Lake
4. Barkerville
5. Wells Gray
6. Groundhog
7. Columbia North
8. Central Rockies
9. Frisby-Boulder
10. Columbia South
11. Duncan
12. Monashee
13. Nakusp
14. Purcells South
15. South Selkirks
Border between the COSEWIC's Northern Mountain and Southern Mountain National Ecological Areas
Hart River
Bonnet Plume
Moose Lake
Redstone
Chisana
Kluane
Aishihik
Tay River
Finlayson
South Nahanni
Coal River
Wolf Lake
Carcross
Atlin
Little Rancheria
Liard Plateau
Level Kawdy
Horseranch
Rabbit
Muskwa
Tsenaglode
Edziza
Spatsizi
Frog
Gataga
Pink Mountain
Finlay
Chase
Wolverine
Scott
Moberly
Burnt Pine
Kennedy
Quintette
Narraway
Redrock Prairie Creek
A La Peche
Tonquin
Maligne
Brazeau
Banff
George Mountain
Itcha-Ilgachuz
Charlotte Alplands
Central Purcells
NECHAKO PLATEAU
ALBERTA
Kamloops
Kelowna
Vancouver
0 125 250 500 Km

Sources: Esri, DeLorme, HERE, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, and the GIS User Community

Figure 2. Caribou subpopulations in the Northern Mountain DU(7), Central Mountain DU(8) and Southern Mountain DU(9). The border between COSEWIC's Northern and Southern Mountain National Ecological Areas depicts the COSEWIC (2002) Northern and Southern Mountain Population boundaries. Map created by Bonnie Fournier (Environment and Natural Resources, Government of the Northwest Territories, 2013).

Serrouya *et al.* (2012) found that caribou subpopulations located north of the Peace River formed one distinct cluster. However, the two west-central BC subpopulations sampled (Itcha-Ilgachuz, Tweedsmuir) more closely resembled caribou south of the Peace River. Zittlau (2004) concluded that the two west-central BC subpopulations were more closely related to caribou in southeastern BC than to caribou sampled from northern BC. Of the subpopulations sampled from northern and west-central BC, the Itcha-Ilgachuz subpopulation had the lowest level of microsatellite diversity and was highly distinct (94% self assignment), likely due to its isolation (along with neighbouring Tweedsmuir-Entiako subpopulation) from other subpopulations (Zittlau 2004). The three sampled northern BC subpopulations (Atlin, Carcross, Cassiar) clustered together as did the three north-central BC subpopulations (Wolverine, Finlay, Chase). Zittlau (2004) also detected high microsatellite differentiation among three Yukon/BC subpopulations (Aishihik, Chisana, Wolf Lake) as well as high levels of genetic diversity within each of these subpopulations, which she hypothesized reflected the admixture of subpopulations in unglaciated regions during the last ice age. Kuhn *et al.* (2010) found four genetic clusters within subpopulations in Yukon. One of those clusters, which included Ibex, Carcross, and Atlin, was genetically distinct.

McDevitt *et al.* (2009) reported high differentiation that was significant ($p<0.05$) among subpopulations of caribou from east-central BC/west-central Alberta using mitochondrial data (F_{ST} 0.018 – 0.5619) and microsatellite data (F_{ST} 0.01-0.09). The A La Peche subpopulation clustered with Jasper and Banff National Park subpopulations, and the Red Rock Prairie Creek and Narraway (including Bearhole/Redwillow) subpopulations formed one cluster. The subpopulations in the northern part of the area (Quintette, Moberly, Burnt Pine, Kennedy Siding) clustered with the only southeastern BC subpopulation sampled (Hart Ranges - Parsnip portion). Conversely, Weckworth *et al.* (2012) found that the Jasper and Banff subpopulations clustered with one of the two southeastern BC subpopulations sampled (North Cariboo), while the A La Peche subpopulation clustered with other subpopulations from the area. Serrouya *et al.* (2012) found that the Peace River was an important source of genetic separation. The Graham subpopulation on the north side of the river was distinct from subpopulations to the south of the river. All subpopulations from east-central BC/west-central Alberta were included in the cluster that contained subpopulations south of the Peace River and north of the North Thompson River, except for the Jasper subpopulation, which was not well-classified into any cluster (Serrouya *et al.* 2012). Boreal caribou did not cluster with caribou from east-central BC/West-central Alberta in all three studies (McDevitt *et al.* 2009, Serrouya *et al.* 2012, Weckworth *et al.* 2012).

Serrouya *et al.* (2012) conducted the most extensive assessment of microsatellite genotypes of southeastern BC caribou (13 subpopulations). Zittlau (2004), McDevitt *et al.* (2009), and Weckworth *et al.* (2012) carried out separate studies, with a secondary focus on southeastern BC subpopulations. Some subpopulations in southeastern BC exhibit pronounced structuring, likely as a result of small populations that have experienced more genetic drift, although no meaningful genetic differentiation was detected between the Hart Ranges and the North Cariboo, nor among the Columbia North, Groundhog, Frisby-Boulder, Nakusp, and Duncan subpopulations (Serrouya *et* *al.* 2012). The lack of genetic differentiation for those 5 subpopulations could be due to historical movement between them, prior to a contemporary barrier to gene flow (Serrouya *et al.* 2012). Major river valleys serve as barriers to gene flow for southeastern BC subpopulations (Serrouya *et al.* 2012). Both Zittlau (2004) and Serrouya *et al.* (2012) found the Purcells South subpopulation to be genetically distinct among caribou subpopulations they sampled.

Designatable Units

COSEWIC defined designatable units (DUs) for caribou in Canada (COSEWIC 2011) using COSEWIC (2013) criteria for discreteness and evolutionary significance. Twelve DUs were defined based on currently available information on lines of evidence that included phylogenetics, genetic diversity and structure, morphology, movements, behaviour and life history strategies, and distribution.

In previous COSEWIC assessments (COSEWIC 2002; 2004), caribou in Canada were organized into eight "Nationally Significant Populations". The subjects of this assessment belonged to two nationally significant populations: Northern Mountain and Southern Mountain (COSEWIC 2002) in the COSEWIC Northern and Southern National Ecological Areas, respectively (Figure 2). Based on more recent information on caribou ecology and genetics, COSEWIC (2011) re-organized these into three DUs: Northern Mountain, Central Mountain and Southern Mountain.

There are two major differences between the new DU structure (COSEWIC 2011) and that of the previous assessment (COSEWIC 2002). One change results from the reclassification of terrestrial lichen feeding/shallow snow caribou that were previously part of the Southern Mountain population. The new Southern Mountain DU, restricted to central and southeastern BC (Figure 2), now includes only the deep snow/arboreal lichen feeding ecotype. In contrast, all shallow snow/terrestrial lichen feeding caribou now belong to either the Central Mountain or Northern Mountain DUs. Subpopulations belonging to the new Central Mountain DU occur along the eastern side of the Rocky Mountains in west-central Alberta and east-central BC with some straddling the provincial border (Figure 2). Representing a division of the previous Southern Mountain 'population', subpopulations in this DU actually have more traits in common with Northern Mountain than Southern Mountain caribou. Central Mountain and Northern Mountain DU caribou share similar winter feeding behaviours and seasonal movement patterns, but they differ phylogenetically and are separated both genetically and geographically by the Peace River (see **Population Spatial Structure and Variability**). Northern Mountain DU subpopulations occur in the northern mountains of Yukon, the southern NT, and west-central and northern BC (Figure 2). This range extends further south into the Southern Mountain ecological area than did the former Northern Mountain population (COSEWIC 2002).

For all three western mountain caribou DUs, individual subpopulations that have been sampled are generally discrete from one another and adjacent populations, including those recognized as members of other DUs (see COSEWIC 2011). The Southern Mountain DU and Central Mountain DUs are discrete from other neighbouring DUs in that phylogenetically, caribou in those two DUs have both northern (Beringian-Eurasian [BEL]) and southern (North American [NAL]) lineages. Caribou sampled in the Northern Mountain DU all come from the BEL lineage. Caribou belonging to the Southern Mountain DU have a distinct behaviour related to their use of habitats found in steep, mountainous habitats with deep snowfall (with an accumulated snowpack of 2-5 m). These extreme snow conditions have led to a foraging strategy that is unique among cervids, that is, the exclusive reliance on arboreal lichens for 3-4 months of the year (COSEWIC 2011). Southern Mountain DU caribou are, therefore, discrete from Central and Northern Mountain DU caribou based on inherited traits, namely behavioural strategies and distributional patterns that have resulted from the steep terrain and high levels of snow accumulation (COSEWIC 2011).

With respect to significance, members of the Southern Mountain DU live and are adapted, at least behaviourally, to specific environments characterized by high-elevation forest communities that support abundant arboreal lichens. This group of caribou differs markedly from other caribou, including those in the adjacent DU8, as they have persisted in an ecological setting unique to the species that has given rise to local adaptations. As noted above, caribou in the Central Mountain and Northern Mountain DUs differ phylogenetically. Evidence from McDevitt *et al.* (2009) was suggestive of a "hybrid swarm" of two caribou lineages within the ice-free corridor that appeared along the eastern front of the Canadian Rockies (Central Mountain DU) producing a unique, mixed gene pool at the end of the Wisconsin glaciations ca. 14 000 years ago. Although some evidence indicates genetic relatedness between Northern Mountain DU subpopulations in west-central BC and caribou in the Central Mountain DU, the majority of subpopulations of Northern Mountain DU caribou are genetically different from Central Mountain DU caribou (Serrouya *et al.* 2012).

Further work needs to be conducted to assess phylogenetics and genetic population structure in the Northern Mountain DU in particular. Although all caribou in the 9 subpopulations of caribou that have been sampled in the Northern Mountain DU belonged to the northern clade (Dueck 1998, Zittlau 2004, Weckworth *et al.* 2012), this represents only 20% of the subpopulations, with 8 located in Yukon or along the Yukon/BC border. Only two of the 25 subpopulations in northern BC have been sampled, leaving a large gap in phylogenetic information for Northern Mountain DU. Further work is also needed to clarify genetic relationships in the Southern Mountain and Northern Mountain DUs. Based on limited samples, subpopulations in the west-central BC were found to be genetically more similar to subpopulations in the Southern Mountain DU (Zittlau 2004) and the Central Mountain DU (Serrouya *et al.* 2012) than to other Northern Mountain DU subpopulations. A comprehensive analysis across all DUs is required. There is modest overlap between DUs; however, these boundary areas are limited and there is little inter-mixing of caribou by use of seasonally distinct habitats.

Special Significance

Caribou are an iconic Canadian wildlife species appearing on the Canadian 25 cent coin, and are one of Canada's most widely distributed large mammals (Species at Risk Public Registry 2013). Western mountain caribou display particular adaptations to weather and topographic conditions in mountainous forests along the western spine of the North American continent. By virtue of their reliance on large tracts of older forest, they are highly sensitive to forest clearing and are regarded as indicators of older and intact forest ecosystems. Over 90% of the distribution of western mountain caribou occurs in Canada (see **Global Distribution**).

In western Canada, caribou have played an important sustenance role for Aboriginal peoples, as well as for early fur traders and settlers (Birchwater 1993, Spalding 2000, Olsen *et al.* 2001, Botkin *et al.* 2005, Littlefield *et al.* 2007). Caribou are hunted recreationally and for sustenance in most of the Northern Mountain DU. Caribou are valued as trophy animals and resident and guided hunting of caribou are of economic importance in northern BC, Yukon and the Mackenzie Mountains in the NT. Caribou in all three DUs are also valued for wildlife tourism/wildlife viewing.

DISTRIBUTION

Global Range

Caribou and reindeer are indigenous to arctic, sub-arctic, boreal, and sub-boreal biomes (Banfield 1961, Røed *et al.* 1991). Caribou in the three western mountain DUs occur mostly in Canada, with the exception of the South Selkirk subpopulation range in the Southern Mountain DU (extending into Idaho and Washington) and that of the Chisana subpopulation in the Northern Mountain DU (in Yukon extending into Alaska). No evaluation has been undertaken to clarify which, if any, other the other 27 caribou subpopulations in interior Alaska (e.g., Delta, Denali, etc.; ADFG 2011) belong to Northern Mountain Caribou DU. In the 19th century, western mountain caribou occurred as far south as the Salmon River in Idaho (Figure 3) but are now extirpated, except for the South Selkirk subpopulation; the last confirmed report of a caribou in Montana was in 1958 (US Fish and Wildlife Service 1993).

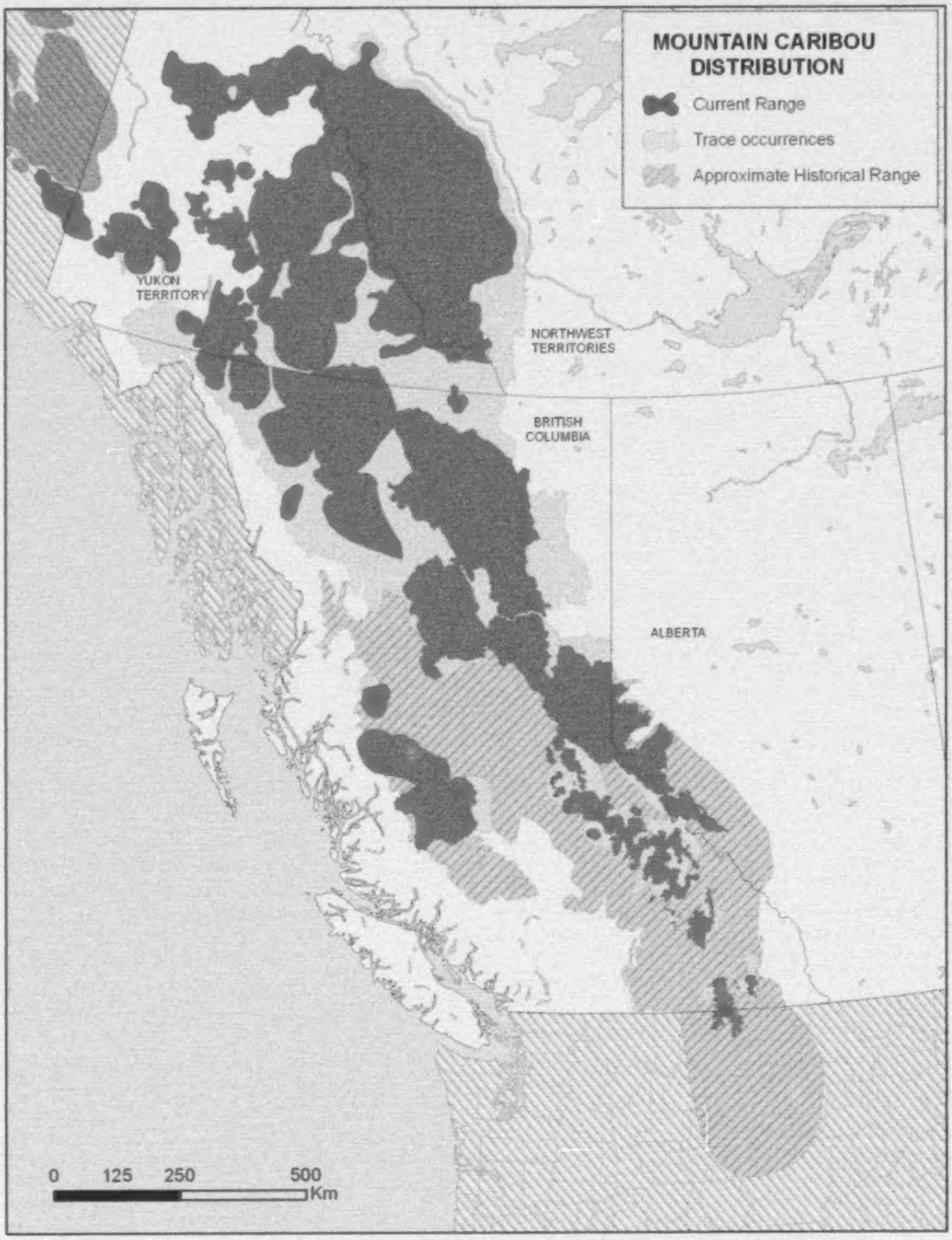

MOUNTAIN CARIBOU DISTRIBUTION
Current Range
Trace occurrences
Approximate Historical Range
YUKON TERRITORY
NORTHWEST TERRITORIES
BRITISH COLUMBIA
ALBERTA
0 125 250 500 Km

Figure 3. Approximate historic and current ranges of caribou in the mountain DUs of western Canada. Map created by Bonnie Fournier (Environment and Natural Resources, Government of the Northwest Territories, 2013).

Canadian Range

Historically, caribou in the mountain DUs of western Canada enjoyed a considerably broader distribution than they do currently (Figure 3). Caribou range in BC has been reduced by 20% since the early 1900s (Spalding 2000) with the major change in distribution occurring in the southern portion of the province. ATK holders have reported that caribou range has decreased in the Fraser and Columbia river basins (Hudson and Ignace 2004). In north-central BC, caribou used the Mount Milligan area in the late 1930s (McKay 1997, Santomauro *et al.* 2012) and in west-central BC, the Tsilhqot'in people used to hunt caribou in the early 1900s (Tsilhqot'in Nation v. British Columbia 2007). Caribou are no longer found in either of those areas. In Alberta, Dzus (2001) found that caribou occupied only about 39% of the generalized maximum historical range (Edmonds 1991); range has continued to recede since that time.

Northern Mountain DU (7)

Caribou in the Northern Mountain DU are distributed among 45 subpopulations ranging from west-central BC to Yukon and NT in the north, including 9 subpopulations in central BC that were part of the former Southern Mountain population of Woodland Caribou (Figure 2; Environment Canada 2014). In Yukon, 26 subpopulations of caribou in the Northern Mountain DU occupy much of the territory south of latitude 65° N. Two of these—Hart River and Bonnet Plume—overlap the winter range of the Porcupine herd of barren-ground caribou and the Forty-mile herd (no affixed DU). The Chisana subpopulation straddles the Yukon-Alaska border. Of the 26 subpopulations in Yukon, 5 are shared with NT and 6 are shared with BC (Figure 2).

Subpopulations in the southern part of the DU have relatively discrete ranges, while range overlap is more pronounced further north. Caribou from the Little Rancheria, Horseranch, Swan Lake and Level-Kawdy subpopulations share overlapping winter ranges, making it difficult to determine the subpopulation origin of caribou counted on the winter range without the aid of radio-collars (M. Williams, pers. comm. 2013). In Yukon, the Laberge subpopulation was only recently identified because it shares the same winter range as the Carcross subpopulation and was previously considered a part of that subpopulation (T. Hegel, pers. comm. 2013). Gaps between subpopulations tend to be wider in BC than in Yukon and NT. Search effort in some of those gaps has been limited but some are known to contain caribou (Thiessen 2009, McNay 2012, MacDonald and McNay 2013). It is unclear whether caribou found in areas between delineated ranges in northern BC belong to adjacent subpopulations or whether they belong to yet unidentified subpopulations (McNay 2012). In Yukon, caribou in the Klaza, Aishihik, Kluane, and Chisana subpopulations are separated from other subpopulations by the Yukon River (T. Hegel, pers. comm. 2013).

Caribou distribution in the northern portion of the Northern Mountain DU has experienced no reduction during the past century, but range recession has occurred in the southern portion of the DU in west-central and north-central BC (Figure 2). Historically, caribou were found throughout the interior plateau region of BC, but are largely absent from that area now (Figure 2, Spalding 2000). From 1984 to 1991, 52 caribou from the Itcha-Ilgachuz subpopulation were transplanted to unoccupied range in the Charlotte Alplands (Young *et al.* 2001), resulting in the re-establishment of some former range in that area.

Central Mountain DU (8)

The Central Mountain DU includes 10 extant subpopulations of caribou in east-central BC and west-central Alberta located in and around the Rocky Mountains, all of which belonged to the former Southern Mountain population of Woodland Caribou (Figure 2; Environment Canada 2014). There are now 3 subpopulations (Tonquin, Maligne, Brazeau) recognized within Jasper because caribou no longer move among those ranges (L. Neufeld, pers. comm. 2012). Caribou range in this DU recently receded with the death of all 5 individuals in the remnant Banff subpopulation in an avalanche in 2009 (Hebblewhite *et al.* 2010b). The Burnt Pine subpopulation was confirmed extirpated in 2014 (BC Ministry of Environment, unpublished data). Caribou in the A La Peche subpopulation have mostly abandoned their traditional annual migration to foothills winter range and now spend most of their time in the mountains, further reducing the amount of range occupied (ASRD&ACA 2010). Using historical records of caribou distribution, Edmonds and Bloomfield (1984) documented that caribou in the Alberta portion of the Central Mountain DU have disappeared or only remain as fragmented remnant populations.

Southern Mountain DU (9)

Caribou in the Southern Mountain DU are distributed across 15 extant subpopulations in southeastern BC, all of which belonged to the former Southern Mountain population of Woodland Caribou (Figure 2; Environment Canada 2014). About 80% of the population is found in ranges north of the North Thompson River (Serrouya *et al.* 2012). Since 2002, two additional subpopulations have been confirmed extirpated (George Mountain in 2003; Central Purcells in 2005), with several others having fewer than 10 individuals (see **Population Sizes and Trends**).

Wittmer *et al.* (2005a) reassessed distribution and subpopulation structure of Southern Mountain DU caribou and identified 17 subpopulations (excluding the South Selkirks) with a total range area of 28 357 km^2. Since then, the Allen Creek subpopulation was combined with the Wells Gray subpopulation and some subpopulations were renamed, but those range areas are essentially the same as the current ranges. Wittmer *et al.*'s (2005a) total range represents a 54% reduction from the previous total range estimate of 61 290 km^2 (excluding the South Selkirks; MCTAC 2002). Although the earlier total range estimate was based on known or suspected occupancy (MCTAC 2002), the reduction in range reflects a reduction in subpopulation numbers and increasing fragmentation and isolation of subpopulations, especially in the southern portion of the DU (Wittmer *et al.* 2005a).

Van Oort *et al.* (2011) assessed additional radio-collared caribou location data and found that the distribution of caribou in the subpopulations recognized by Wittmer *et al.* (2005a) plus South Selkirks were composed of 41 summer/fall composite ranges with almost no evidence of movements between them. They concluded that the subpopulations were not functioning as a metapopulation due to the lack of dispersal.

Extent of Occurrence and Area of Occupancy

As caribou population size decreases, they occupy less of their range (Bergerud 1996, Schaefer 2003). Caribou may also focus their use in a portion of their range in response to disturbance (Smith *et al.* 2000, Seip *et al.* 2007). Although it may be difficult to determine why the population is occupying less range, both situations indicate suboptimal conditions for caribou.

The current extent of occurrence (EO) was measured by fitting a minimum convex polygon around the current range of each DU, including trace occurrences (Figure 2). The EO for the three DUs is: Northern Mountain 1,050,174 km^2, Central Mountain 85,986 km^2, and Southern Mountain 118,240 km^2. The index of area of occupancy, based on a 2 x 2 km^2 grid placed on the current subpopulation boundaries (excluding trace occurrences) is: Northern Mountain 523 672 km^2, Central Mountain 46 144 km^2, and Southern Mountain 46 324 km^2. It is likely that the area of occupancy is actually considerably smaller, if measured as "the smallest area essential at any stage to the survival of existing populations" (IUCN Standards and Petitions Subcommittee 2013). However, this was not possible to calculate at the DU scale, as many essential wintering and/or calving ranges for individual subpopulations are unknown or have not been mapped. Both measures of range extent are known to have declined over the past decade, as evidenced by declines or extirpations of several subpopulations (see **Population Sizes and Trends**). However, the revision of DU boundaries since the 2002 assessment (see **Designatable Units**) precludes quantification of this change.

Search Effort

The distribution maps of forest-dwelling caribou in the Northern Mountain, Central Mountain, and Southern Mountain DUs are based on range maps provided by each jurisdiction in 2013. For most subpopulations, range areas have been delineated using positions from radio-collared caribou.

In the Central Mountain and Southern Mountain DUs, extensive radio- and GPS-collared caribou studies have been conducted over several years resulting in thousands of telemetry positions (e.g. Wittmer *et al.* 2005a, Jones 2007, ASRD&ACA 2010, van Oort *et al.* 2011, Williamson-Ehlers 2012, Seip and Jones 2013). Most of the radio-telemetry studies in the Central Mountain DU were conducted after 2002, so ranges reflect current distribution and range use. In the Central Mountain DU, all but the Scott subpopulation have recent information on range use and distribution (S. McNay, pers. comm. 2013). In the Southern Mountain DU, Wittmer *et al.* (2005a) delineated current ranges based on radio-collared caribou studies conducted mostly in the mid- to late 1990s and early 2000s.

In the Northern Mountain DU, most subpopulations have had at least some radio-collared caribou on which to base distributions (Environment Canada 2012). Subpopulations with limited information on ranges and distribution include: Bonnet Plume, Tay River, Moose Lake, Gataga, Rabbit, Edziza, and Tsenaglode. The Frog, Gataga, and Rabbit ranges in BC are adjacent to areas of trace occurrences. Recent surveys of caribou and other species in those areas indicate that caribou are using those areas (Thiessen 2009, McNay 2012, MacDonald and McNay 2013). Twelve caribou were recently radio-collared in this area, which will help refine subpopulation boundaries (MacDonald and McNay 2013). In Yukon, most of the caribou ranges and surrounding areas have been surveyed for caribou or for other species so overall distribution is assumed to be mostly known, notwithstanding the dynamic nature of range occupancy (T. Hegel, pers. comm. 2013).

HABITAT

Habitat Requirements

Topography, climate, and winter feeding habits divide caribou in the western mountainous region of Canada into two general ecotypes (Stevenson and Hatler 1985, Heard and Vagt 1998). In the Northern Mountain and Central Mountain DUs, snow depths are relatively shallow and caribou feed primarily on terrestrial lichens either in low-elevation forest-dominated habitats or on rounded wind-swept peaks (Johnson *et al.* 2001, Jones *et al.* 2007). In the Southern Mountain DU, deep snow causes caribou to eat arboreal lichens found in mid- to high-elevation mountainous habitats (Terry *et al.* 2000).

In general, caribou require large seasonal ranges. These large areas allow caribou populations to segregate from one another (horizontally and altitudinally) from predators and other ungulates, reducing predation on both adults and calves (Bergerud and Page 1987). Also, access to a broad distribution of habitat allows caribou populations to alter their range use in response to natural disturbance processes (e.g. fire, insects, weather/snow conditions) and human activities such as forest harvesting, mining and mineral exploration, oil and gas development, and recreation activities (McKay 1997, MCTAC 2002, NCTAC 2004, McNay *et al.* 2008, Environment Canada 2012). High disturbance (anthropogenic and natural) levels and young forest cover within a population range can both preclude options for caribou shifts to suitable habitat and lead to changes in ecological interactions within the system at large; the result is lower survival rates (Wittmer *et al.* 2007, Williamson-Ehlers *et al.* 2013).

During winter, caribou require large patches of winter habitat including low-elevation mature pine forests with abundant terrestrial lichens (Central and Northern Mountain DUs), low-elevation mature forests (pine or spruce) or forested wetlands with abundant arboreal lichens (Central and Northern Mountain), high-elevation windswept alpine ridges with abundant terrestrial lichens (Central and Northern Mountain), high-elevation mature subalpine forests with abundant arboreal lichens (all DUs) and low-elevation cedar-hemlock forests (Southern Mountain only). For Central and Northern DU caribou, snow depth or hardness can limit access to terrestrial lichens (Cichowski 1993, Johnson *et al.* 2001).

Relative to the winter season, the diet of caribou is general in other seasons, reflecting the use of a broader range of habitats during the spring, summer and fall. Typically, caribou calve in areas that are isolated or distant from predators (e.g. high-elevation alpine, subalpine parkland, subalpine forests, islands in lakes). Females often forgo forage quality at low elevations to calve in high-elevation habitat in late May/early June where forage at that time of year is limited (Bergerud *et al.* 1984). Those that used lower elevations in May had higher fecal nitrogen concentrations than caribou that remained in the subalpine habitat (Seip 1992). For those in northern BC, calving sites are associated with high-quality forage, and higher calf survival corresponded with movements away from calving sites to increase access to forage and/or minimize predation risk (Gustine *et al.* 2006). Relatively undisturbed “matrix range” (*sensu* Environment Canada 2014) is necessary for seasonal migrations and connectivity between ranges that maintain or increase genetic diversity, reduce predation risk, and provide potential movement corridors to facilitate response to changing conditions caused by climate change.

Northern Mountain DU (7)

Northern Mountain caribou generally live in relatively shallow snow areas where they forage primarily on terrestrial lichens, either in low-elevation mature coniferous forests or on windswept alpine slopes (Cichowski 1989, Wood and Terry 1999, Gullickson and Manseau 2000). These animals prefer older pine or spruce forests where terrestrial lichens are abundant, but they also forage on arboreal lichens, especially during late winter or when snow crusting affects their ability to crater (Cichowski 1989, Johnson *et al.* 2001). Some subpopulations forage on arboreal lichens in subalpine habitat during portions of, or all of the winter. At low elevations, caribou use frozen lakes where they crater for ice and/or free water.

The Northern Mountain DU extends from central BC to the NT and spans a variety of ecological conditions. As such, variation in seasonal behaviour reflects differences in topography, snow accumulation, and availability of low-elevation winter ranges between areas. In Yukon, caribou use various winter range strategies; for example, the Chisana, Kluane, Aishihik, and Klaza subpopulations use alpine ranges, whereas seven subpopulations to the east forage in lower-elevation forests (Kuzyk *et al.* 1999). In BC, the Telkwa and Takla caribou subpopulations in the central part of the province primarily use high-elevation subalpine and alpine habitats throughout the year (Stronen 2000, Poole *et al.* 2000). Subpopulations in north-central BC use low-elevation forests in early winter, then generally move to higher-elevation subalpine and alpine habitat in late winter (Terry and Wood, 1999, Wood and Terry 1999), although individuals may spend the whole winter in alpine habitat or low-elevation habitat (Johnson *et al.* 2002). Individual caribou in subpopulations in west-central and northern BC use low elevations or high-elevation subalpine/alpine most of the winter although during some years, a portion of the Tweedsmuir-Entiako subpopulation move into high-elevation subalpine/alpine habitat from mid-February to mid-March (Cichowski 1989, Young and Roorda 1999, Cichowski and MacLean 2005).

Some Northern Mountain subpopulations, or portions of subpopulations, migrate long distances between winter and summer ranges, whereas others do not. During calving (late May to early June), female caribou generally move to high-elevation mountain areas away from predators and other prey (Bergerud *et al.* 1984). They may also use islands in lakes as an anti-predator strategy (Seip and Cichowski 1996, Cichowski and MacLean 2005). Caribou that calve at higher elevations and caribou that calve at low elevations on islands in lakes tend to have higher neonatal calf survival than those that calve below treeline but not on islands (Seip and Cichowski 1996). During summer, habitat use varies and caribou can be found in a variety of habitats ranging from low-elevation forests to alpine habitat. During the rut, some subpopulations move to rutting areas at higher elevations while others rut on their summer ranges.

Current understanding of caribou habitat use patterns in the Northern Mountain DU based on scientific information is consistent with ATK of caribou habitat use. In north-central BC, Takla, Tl'azt'en, Nak'azdli and Tsay Keh Dene described seasonal habitat use where caribou began appearing at low elevations in April and May and used pine-dominated areas with abundant "white moss", lakes to "lick the clear ice", and mineral licks where they were available (McKay 1997, McNay *et al.* 2008, Santomauro *et al.* 2012). Caribou then disappeared in late May, presumably moving to higher elevations for calving because caribou were seen with calves at higher elevations during summer (McNay *et al.* 2008). In early summer, caribou were seen lying on snow patches, which was likely a strategy to avoid flies, and caribou used lakes during ice-free times as a refuge from wolves (*Canis lupus*; McKay 1997, McNay *et al.* 2008). Caribou stayed at high elevations during the rut to "dry their horns" then moved back down to low elevations for early winter to avoid fresh snow at higher elevations; some caribou, but not always all caribou, disappeared in January, presumably to use higher elevations for the rest of the winter (McNay *et al.* 2008). In the Atlin area, Taku River Tlingit members indicated that during winter, caribou selected low-elevation forests, especially mature Lodgepole Pine (*Pinus contorta*) stands with high lichen ground cover, and during summer, caribou were wide-ranging and used mountain sides where they forage on grass, willow, and lichen (Polfus *et al.* 2014).

Central Mountain DU (8)

Like Northern Mountain DU caribou, caribou in the Central Mountain DU also live in relatively shallow snow areas where, during winter, they forage primarily on terrestrial lichens in lower-elevation forests or on windswept alpine slopes (Edmonds and Bloomfield 1984, Brown *et al.* 1994, Szkorupa 2002, Jones 2007, Shepherd *et al.* 2007).

In Alberta, caribou in the Central Mountain DU typically winter in old pine or mixed pine/spruce/fir forests in the foothills of the Rocky Mountains where they predominantly crater for terrestrial lichens, and then move in spring to summer range in the mountains. During calving, female caribou are highly dispersed and use habitats in mountainous terrain. In recent years, the migratory behaviour of the Jasper subpopulations (Tonquin, Maligne, Brazeau), as well as the A La Peche and Redrock-Prairie Creek subpopulations has changed. Most caribou in those subpopulations no longer use the low-elevation foothills portions of their ranges and are living in the mountains all year round (Smith 2004, L. Neufeld, pers. comm. 2013). Elders from one community in west-central Alberta observed that the A La Peche subpopulation stays around all year and that grizzly bears (*Ursus arctos*), wolves, and cougars (*Puma concolor*) have increased in the area, which may further affect caribou (West Central Alberta Caribou Landscape Planning Team 2008). Currently, adult survival is lower for caribou that migrate to low-elevation foothills areas for winter than for those that live year-round in the mountains, suggesting selection against the migratory behaviour (Hebblewhite *et al.* 2010a).

Caribou in the BC portion of the Central Mountain DU exhibit varying seasonal habitat use patterns (Jones 2007, Williamson-Ehlers 2012). The Kennedy Siding subpopulation uses low-elevation mature pine forests during the rut and early winter then moves to higher-elevation subalpine and alpine habitat for mid- to late winter. The Moberly, Burnt Pine, and Quintette subpopulations are primarily found in alpine and subalpine habitat throughout the year, except during calving and summer/fall when they use more subalpine forested habitat.

Southern Mountain DU (9)

Range use by deep snow/arboreal lichen feeding caribou varies seasonally (Seip 1990, 1992a, Jones 2007). In early winter, caribou use valley bottoms and lower slopes where they forage primarily on arboreal lichens on fallen trees and lichen litterfall, but also on shrubs and forbs that remain accessible in snow wells (Seip 1992a, Mowat *et al.* 1998, Terry *et al.* 2000). In early winter, the snowpack is soft and deep so habitats with conifer canopies that intercept snow, enabling access to feeding sites, are important. Use of early winter habitats varies across the range of caribou in the Southern Mountain DU. In general, caribou that live in rugged mountainous terrain make more pronounced migrations to lower-elevation cedar/hemlock and mid-elevation spruce/subalpine fir (*Abies lasiocarpa*) forests, whereas caribou that live in more highland type terrain or at the north and south ends of the range, primarily use mid- and upper-elevation forests (Terry *et al.* 1996, Apps *et al.* 2001).

In mid- and late winter, caribou move to upper slopes and ridge tops after the snow pack deepens and hardens, where they forage on arboreal lichens in subalpine parkland habitats dominated by subalpine fir (Seip 1990, 1992a, Simpson *et al.* 1997, Hamilton *et al.* 2000, Apps *et al.* 2001). During winter, caribou forage almost exclusively on arboreal lichens, predominantly *Bryoria* spp. (Terry *et al.* 2000). Foraging may be more difficult in years with relatively low snow packs or poor snow consolidation and when snowpack is >1.5 m lower than normal, caribou may use habitats 300-600 m lower than normal during late winter (Kinley *et al.* 2007).

In spring, caribou descend to access new green vegetation and use ranges similar to early and late winter ranges (Seip 1990, 1992a, Hamilton *et al.* 2000). Pregnant caribou move upwards again in May to higher-elevation calving habitats where predators are less abundant, although forage is limited (Seip 1990, 1992a, Hamilton *et al.* 2000, Stotyn 2008). During spring/calving, males generally remain at lower elevations where food is more available than at higher elevations. During summer, caribou use subalpine, subalpine parkland, and alpine areas where they forage on a variety of herbs and shrubs (Seip 1992a).

Habitat Trends

Change in habitat quality or availability has both direct and indirect impacts for caribou populations from the three DUs (see **Threats and Limiting Factors**). A reduction in habitat will directly influence the movement, distribution, and foraging ecology of caribou with a potential decrease in nutritional intake and an increase in the energetic costs of seasonal habitat use (Johnson *et al.* 2002). The link between these costs and reproduction and survival for small low-density populations of caribou are less certain (McLellan *et al.* 2012). Indirectly, habitat change may support other ungulate species and larger or more widely distributed predator populations across caribou range (i.e., apparent competition; Serrouya *et al.* 2011). Habitat change may be the result of both natural disturbance, such as fire and insect outbreaks, and anthropogenic activities including forestry, mining, and energy development. Also, disturbance related to human activities may force caribou to move away from otherwise functional habitat (Seip *et al.* 2006). For many caribou subpopulations, the long-term cumulative impacts of habitat change are more notable than any one disturbance type or event (Nitschke 2008, Williamson-Ehlers *et al.* 2013).

For western mountain caribou, habitat change has been related empirically to reduced spatial separation between caribou and other prey or predators (Peters 2010, Robinson *et al.* 2012), changes in distribution including smaller seasonal ranges or abandonment of large areas of habitat (Smith *et al.* 2000, Apps and McLellan 2006, Seip *et al.* 2006, Wittmer *et al.* 2007), reduced survival of caribou (Smith 2004, Wittmer *et al.* 2007), and to population declines (Wittmer *et al.* 2007). The fragmentation of the once continuous distribution of western mountain caribou into multiple small and isolated subpopulations (particularly the Southern and Central Mountain DUs; Figure 2) is indicative of a long-term (>3 generations) decline in the area and connectivity of functional habitat for these animals (Spalding 2000).

Most habitat patches within the Central and Southern Mountain DUs apparently do not support viable populations (see **Population Abundance and Trends**), although two subpopulations (Hart Ranges and Wells Gray) comprise more than half the number of individuals in the Southern Mountain population. By contrast, all individuals in the Central Mountain DU belong to non-viable subpopulations, hence meeting the IUCN definition of “severely fragmented” (IUCN Standards and Petitions Subcommittee 2013). Similarly, extensive alteration of caribou habitat in the Peace-Moberly region of north-eastern BC (within the Central Mountain DU) has occurred as a result of energy development and commercial logging activities that increased greatly in the early 1990s (Nitschke 2008, Williamson-Ehlers *et al.* 2013). Land-use changes are locally significant, but cover a much smaller proportion of the range of the Northern Mountain DU. The recent Mountain Pine Beetle (*Dendroctonus ponderosae*) epidemic in BC and Alberta has resulted in wide-scale salvage logging in beetle-killed areas (McNay 2011). This has the largest impact on habitats for the Northern Mountain DU particularly for subpopulations in the southern and western portions of the DU; there are also significant areas of dead pine and salvage logging across the Central Mountain DU. Proposed development of wind energy may have significant impacts on the quality or availability of alpine habitats. There are also a number of oil and gas pipelines that have been proposed for the region (British Columbia Environmental Assessment Office 2014, Energy BC 2014, Lamers 2014).

Northern Mountain DU (7)

Many caribou subpopulations in the Northern Mountain DU are in relatively remote areas. Forest harvesting is currently the most significant industrial activity in the southern portion of the Northern Mountain DU. At a more localized scale, mineral exploration and development activities occur throughout the DU. The level of anthropogenic disturbance in this DU is expected to increase. Forest harvesting is continuing on ranges in west-central and north-central BC and in some areas harvesting has increased to salvage Mountain Pine Beetle-killed stands (Bogdanski *et al.* 2011). Mineral exploration and development activities have increased on most ranges in the southern Yukon and in portions of central and northwestern BC (PWC 2012; see **Threats and Limiting Factors**). In an area known as the "Golden Triangle" in north-western BC, there are over 30 known large mineral deposits and at least five giant pit mines in the planning process. The 344 km, 287 kV Northwest Transmission line is being built from Terrace to Bob Quinn Lake for the purposes of supplying power to planned industrial developments and remote communities in the area. In 2013, BC Hydro announced it would extend the transmission line to the Red Chris mine, which lies close to if not within the western boundary of the Spatsizi subpopulation range. Expected to be in operation by mid-2014, the new power supply is likely to increase the feasibility of potential projects in and adjacent to caribou ranges in northwestern BC (BC Hydro 2013).

Central Mountain DU (8)

Forest harvesting and mineral and hydrocarbon exploration and development have all contributed to habitat change in the Central Mountain DU (ASRD&ACA 2010, Ehlers *et al.* 2014). Williamson-Ehlers *et al.* (2013) recently assessed landscape level habitat change for four of the eleven subpopulations in the Central Mountain DU. The footprint area of industrial disturbance included 39% of the Moberly/Burnt Pine ranges, 33% of the Quintette range, 19% of the Bearhole/Redwillow portion of the Narraway range, and 11.5% of the rest of the BC portion of the Narraway range. They used positions from 139 GPS-collared caribou to model avoidance behaviour and calculate zones of influence for individual populations relative to wild fire, coal mining, oil and gas exploration and development, and forest harvesting. The greatest amount of habitat change created by industrial development occurred between 2000 and 2009; this time period coincided with known caribou declines on most ranges (Seip and Jones 2013).

The Forest Practices Board of BC recently undertook a cumulative effects assessment of the Kiskatinaw River Watershed, which included caribou habitat in the Bearhole/Redwillow portion of the Narraway range. They found that 50% of the core habitat present in the winter range in the mid-1980s had been lost by 2007 (Forest Practices Board 2011). No animals were found in the Burnt-Pine range in 2012 (Seip and Jones 2013) when at least 39.4% of the neighbouring annual range (with Moberly) contained industrial developments.

Southern Mountain DU (9)

In the Southern Mountain DU, forest harvesting has been the primary source of habitat alteration (MCTAC 2002). Although logging took place in southeastern BC (Southern Mountain DU) from the early 1900s, it was not until the 1970s that large amounts of habitat were lost (Spalding 2000). MCTAC (2002) compared the estimated amount of suitable historical and current habitat. Habitats were rated in 6 classes ranging from Very High to Nil. The amount of historical habitat was calculated based on the assumption that habitat was in the old-growth forest state, the optimal state for caribou. Current suitability was rated based on estimates of the current amount of old-growth forests and habitat fragmentation associated with industrial development. For the top three suitability classes combined (Very High, High, Medium), the extent of currently suitable habitat was 38% lower than the extent of historically suitable habitat. The greatest decline was in the High class, where the amount of currently suitable habitat was 71% lower than the historical level.

BIOLOGY

Life Cycle and Reproduction

Detailed background information on the general biology of caribou can be found in Banfield (1974), Kelsall (1984), Miller (1982), Bergerud (2000), and COSEWIC (2011).

The reproductive rate of caribou is low compared to other members of the deer family. Caribou usually have only one calf per year and females do not generally breed until they are at least 2 years old (Bergerud *et al.* 2008). Where data on age-specific reproduction are available among caribou ecotypes, they suggest an early age of primiparity (e.g. Rettie and Messier 1998). Pregnancy rates are often high for western mountain caribou (> 90%, Seip and Cichowski 1996; ~92 ± 2%, Wittmer *et al.* 2005a) and do not differ among subpopulations in BC (Wittmer *et al.* 2005a) or elsewhere in North America (Bergerud *et al.* 2008). High pregnancy rates suggest that nutrition is not limiting because caribou pregnancy rate is highly sensitive to forage availability (Cameron *et al.* 1993) and delay in primiparity is among the most sensitive indicators of food limitation in mid-sized ungulates (Gaillard *et al.* 1998, 2000). Pregnant females travel to isolated, relatively predator-free areas in the mountains to calve in late May or early June (Edmonds 1988, Farnell and McDonald 1990, Seip 1990, 1992a, Jones 2007). Neonatal calf survival is higher for females that calve at high elevations in mountainous terrain or below treeline on islands in lakes (where predators are less abundant), than for females that calve below treeline but not on islands (Seip and Cichowski 1996). Tsay Key Dene ATK holders noted that caribou use high-elevation sites near the treeline for calving. Caribou prefer sites with a south aspect and deep snow conditions, providing protection from harassment/disturbance by either humans or predators (McKay 1997, McNay *et al.* 2008).

Calf survival during the first few months after birth tends to be low, with most calf mortality occurring by the fall after birth. For example, a number of caribou herds in the Northern Mountain DU show a consistent pattern of a high level of calf mortality over the first two months of life, followed by summer and winter calf mortality rates that vary among herds. While most calf mortality has occurred by the fall after birth, for herds studied in northern BC (Swan Lake, Little Rancheria and Horseranch) a significant level of calf mortality can occur over the winter and the timing and extent of calf mortality varies among years and among herds (MFLNRO unpublished data). Calf mortality during the first two months of life ranged between 21% and 46% for the Pink Mountain subpopulation (Gustine *et al.* 2006a). By fall, 3 to 39% of radio-collared female caribou still had calves in the Spatsizi, Tweedsmuir, Wells Gray (south), and Wells Gray (north) subpopulations (Hatler 1986, Seip 1990, 1992a, Cichowski and MacLean 2005). In late winter, reported % calves has ranged from 1 to 23% (average 12%) for Southern Mountain DU subpopulations (Wittmer *et al.* 2005a), 9 to 15% for subpopulations in the Central Mountain DU (Seip and Jones 2013), and 10 to 18% for subpopulations in the Northern Mountain DU (Young and Freeman 2001, Cichowski and MacLean 2005, Tripp *et al.* 2006, Florkiewicz 2008, McNay *et al.* 2010, BC MFLNRO unpublished data). According to Tlingit ATK holders, the Carcross caribou subpopulation has appeared to have low recruitment of calves starting in the late 1970s (Botkin *et al.* 2005). Low calf recruitment in other herds in northern BC (MFLNRO unpublished data) has also been documented with only 12 of 20 late winter composition surveys on the Atlin, Swan Lake, Little Rancheria and Horseranch herds between 1995 and 2008 showing calf:100 cow ratios of fewer than 25 calves:100 cows. This lies below the 15% theoretical threshold that Bergerud (1996) suggests is needed to stabilize numbers in forest-dwelling caribou subpopulations. This recruitment threshold is, however, tightly linked to a high (>90%) female survival and could sometimes be insufficient to balance high adult mortality rates (Wittmer *et al.* 2005a).

Adult female (>1 year) survival rate of female caribou varies among subpopulations (see Appendix 1). In the Northern Mountain DU, mean annual survival rates of adult radio-collared caribou ranged from 83% to 90%, and in the Central Mountain and Southern Mountain DUs, mean annual female survival rates ranged from 74% to 92%, and 55% to 96% respectively (Hayes *et al.* 2003, Cichowski and MacLean 2005, Wittmer *et al.* 2005a, Tripp *et al.* 2006, ASRD&ACA 2010, Seip and Jones 2013, BC MFLNRO, unpublished data). Predation has been the major cause of death of radio-collared adults and calves and much of the behaviour of caribou is related to reducing risk of predation (see **Threats - Predation**).

Calculations of generation length for subpopulations with available data from the Northern Mountain, Central Mountain and Southern Mountain DUs (using a formula from IUCN Standards and Petitions Subcommittee 2013) ranged between 8 and 9 years (see Appendix 1).

Physiology and Adaptability

During winter, caribou in the Northern Mountain, Central Mountain, and Southern Mountain DUs forage primarily on lichens, although conifers, shrubs, graminoids, forbs, horsetails (*Equisetum* spp.), and mosses are also ingested (Seip 1990, Farnell and McDonald 1990, Farnell *et al.* 1991, Cichowski 1993, Thomas *et al.* 1996, Gullickson and Manseau 2000). Together with specialized bacteria and protozoa in their rumens for efficient digestion of lichens, caribou are able to recycle urea to conserve nitrogen, of which preferred lichens are deficient (Parker *et al.* 2005). During winter, they use fat reserves to meet energy requirements and catabolize body protein when fat reserves are depleted or their diet is nitrogen deficient (Taillon *et al.* 2013).

In the Northern Mountain and Central Mountain DUs, terrestrial lichens are the primary winter forage except in west-central BC, where arboreal lichens also make up a significant component of the diet (Farnell and McDonald 1990, Farnell *et al.* 1991, Cichowski 1993, Thomas *et al.* 1996, Gullickson and Manseau 2000). Horsetails comprise up to 7% of the winter diet (Farnell and McDonald 1990, Thomas *et al.* 1996, Gullickson and Manseau 2000) and extensive foraging for horsetail in seepage spruce forests has been observed (Cichowski and MacLean 2013). In the Southern Mountain DU, arboreal lichens are the primary winter forage; however, in early winter, caribou also use lower-elevation cedar/hemlock forests where they forage primarily on arboreal lichens (both on standing and fallen trees), but also on terrestrial lichens, conifers, forbs and shrubs (Seip 1992a, Mowat *et al.* 1998, Terry *et al.* 2000, Kinley *et al.* 2003).

During spring, summer and fall, use of lichens decreases while use of vascular and other plants increases. On the Itcha-Ilgachuz caribou range in the Northern Mountain DU, lichens made up over 60% of the diet except from July to October, when they fed primarily on graminoids, forbs, shrubs, and mosses (Cichowski 1993). In the Central Mountain DU, caribou in Jasper Park consumed primarily terrestrial lichens, willows, gramminoids, and forbs (Thomas *et al.* 1996). In the Southern Mountain DU, caribou that moved into lower-elevation cedar/hemlock forests during spring commonly used gramminoids, horsetails, mosses, and conifers (Simpson 1987, Seip 1990), and during summer, forbs, gramminoids, shrubs, and lichens were predominately used (Seip 1990). ATK holders from the Taku River Tlingit First Nation indicated that Atlin area caribou are wide-ranging during summer and use mountainsides and slopes where they forage on grass, willow, and lichen (Polfus *et al.* 2014).

Caribou and reindeer can withstand severe cold because their thick winter coat contains insulating semi-hollow hair (Timisjärvi *et al.* 1984), but they are susceptible to heat stress (Yusef and Luik 1975). The dark summer coat absorbs all wavelengths and suggests the importance of shade and cool forest cover types. Adaptations to snow include large feet and a furred muzzle.

Interspecific Interactions

Caribou are usually one of several prey species in multiple predator-prey systems in the Northern Mountain, Central Mountain, and Southern Mountain DUs. Wolves are the primary predator of caribou (Edmonds 1988, Farnell and McDonald 1988, Seip 1992b, Hayes *et al.* 2003, McNay 2009, Whittington *et al.* 2011); however, bears, cougars, golden eagles (*Aquila chrysaetos*), and wolverine (*Gulo gulo*) also contribute to adult and calf mortality in some areas (Kinley and Apps 2001, Cichowski and MacLean 2005, Wittmer *et al.* 2005b, Gustine *et al.* 2006a, McNay 2009, Milakovic and Parker 2013). Habitat changes brought about by industrial development and increases in early seral forests have led to changing community structure of predators and ungulates, affecting ecological interactions (see **Threats – Predation**). In a multiple predator-prey system, caribou are seldom the primary prey source for predators, but suffer significant mortality.

In the western mountains, caribou co-occur with several ungulate species including moose (*Alces americanus*), elk (*Cervus elaphus*), deer (*Odocoileus* sp.), and wood bison (*Bos bison athabascae*). There is no evidence that caribou actively avoid other ungulates yet separation usually is the case because their use of habitat differs. Nevertheless, as caribou share common predators with many other prey species, predation risk is minimized through spatial segregation of prey species, where the less competitive prey (i.e. caribou) does not use areas where the most competitive prey (e.g. moose) is more abundant (Holt 1984). In western mountains, caribou seem to seek habitat types that are unsuitable to other prey species to ultimately segregate from wolves (Seip 1992). Although competition between caribou and Wood Bison has been a cause for concern by local communities, focused research has failed to find substantial diet, habitat, or spatial niche overlap between these species (Jung and Czetwertynski 2013). In a shared landscape, they employ significantly different positions along the grazer-intermediate-browser gradient (Hofmann 1989), and as such have different dietary requirements, which translate to the use of different habitats and spatial distribution (Jung and Czetwertnyski 2013).

Dispersal and Migration

Northern Mountain DU

In the Northern Mountain DU, caribou generally migrate between summer and winter ranges (Farnell and Russell 1984, Culling *et al.* 2005, Parker and Gustine 2007). However, in some subpopulations, individual caribou may remain on the winter range (Gullickson and Manseau 2000, Culling *et al.* 2005) or on the summer range (Cichowski

1993, 2010, Backmeyer 2000) all year. For example, some collared individuals of the Redstone showed seasonal migratory movements while others were sedentary year round; ATK holders from the Sahtu speak of a sedentary herd (Olsen et al 2001, J. Nagy pers. comm.) Individuals may also exhibit plasticity in migrational behaviour. On the Tweedsmuir range, for example, one caribou moved to low-elevation winter range for two winters, then remained on high-elevation summer range during the third winter (Cichowski 2010). During spring migration, caribou mainly use low-elevation snowfree areas in valley bottoms (Farnell and Russell 1984, Cichowski 1993, Steventon 1996, Backmeyer 2000) and females initiate spring migration earlier than males (Hatler 1986). Fidelity to calving areas is high but fidelity to winter areas is more variable (Wood and Terry 1999, Gullickson and Manseau 2000, Tripp *et al.* 2006). Although caribou return to the same general area during winter, they may use different parts of the winter range in different years and/or move between portions of the winter range during each winter (Hatler 1986, Cichowski 1993, Terry and Wood 1999, Culling *et al.* 2005). Some subpopulations or portions of subpopulations may share wintering areas with other subpopulations but move back to their summer/rutting ranges (e.g. Swan Lake, Little Rancheria, Horseranch, Level Kawdy; BC MFLNRO, unpublished data). Few incidents of dispersal between subpopulations have been documented.

Central Mountain DU

In the Central Mountain DU, movement between summer and winter ranges is variable. In Alberta, the Narraway, Redrock-Prairie Creek, and A La Peche subpopulations migrate between summer and winter ranges (Edmonds 1988, Saher 2005), but more recently, the migratory behaviours of the Redrock-Prairie Creek, A La Peche, and Jasper subpopulations (Tonquin, Maligne, Brazeau) have changed; most caribou no longer use the low-elevation foothills portions of their ranges and are living in the mountains all year round (Smith 2004, L. Neufeld, pers. comm. 2013). The subpopulations in BC generally move from wintering areas on the eastern side of the Rocky Mountains to summering areas in the central part of the Rocky Mountains, although some animals remain in wintering areas all year (D. Seip, pers. comm., 2013).

During spring migration, caribou use lower-elevation portions of drainages for travel, and females begin spring migration earlier than males (Edmonds 1988, Saher 2005). Fidelity to calving areas is high (Brown *et al.* 1994, Edmonds 1988). ATK elders have noted that the A La Peche subpopulation has a strong fidelity to their home range, staying around all year despite an increase of grizzly, wolves, and cougars in the area (West Central Alberta Caribou Landscape Planning Team 2008). In BC, some range overlap occurs mostly during summer in the Scott, Kennedy Siding, Moberly, Burnt Pine, Quintette, and Bearhole/Redwillow portion of the Narraway subpopulation (Seip and Jones 2013).

There is little evidence of dispersal between subpopulations. One incidence of dispersal observed between ranges was of the one remaining radio-collared caribou in the Burnt Pine subpopulation, which moved to the Scott range in October 2012, but then returned to the Burnt Pine range in summer 2013 (D. Seip, pers. comm. 2013). The three caribou ranges in Jasper National Park are now recognized as separate subpopulations because caribou no longer move among them (L. Neufeld, pers. comm. 2013).

Southern Mountain DU

In the Southern Mountain DU, migration is generally altitudinal, although some subpopulations also migrate between winter and summer ranges (Seip 1990), and caribou exhibit greater fidelity to calving/summer areas than they do to wintering areas (Wittmer *et al.* 2006). No dispersal between subpopulations has been documented for juveniles, and adult dispersal rate between subpopulations was <0.5% (van Oort *et al.* 2011).

POPULATION SIZES AND TRENDS

Population estimates are difficult to obtain for forest-dwelling caribou as they live in remote areas and occupy large ranges at relatively low densities. Survey techniques have been developed for most subpopulations, but for some, population estimates may be based on extrapolations from other types of data or expert opinion.

Population trends in this status report are based on available survey data and/or population growth rate data. Population estimates for each DU are not compared to previous summaries (e.g. Williams and Heard 1986, Edmonds 1991, Ferguson and Gauthier 1992, Mallory and Hills 1998, COSEWIC 2002) because most of those summaries do not include all of the subpopulations currently recognized in the 3 DUs covered in this report. For most surveys, the number of adults counted during the survey was used to estimate mature individuals (see **Biology**). Most surveys did not classify beyond adult male, adult female, unidentified adult and calves, and most provided no data on yearlings.

Northern Mountain DU (7)

Sampling Effort and Methods

In the Northern Mountain DU a variety of methods were used to estimate population numbers. For subpopulations where a large proportion of the population uses high-elevation alpine/subalpine habitat seasonally, surveys of the open areas provide minimum counts. When available, such as in a mark-resight framework (Hegel *et al.* 2012), the proportion of radio-collared caribou seen is used to correct for caribou missed during the survey and to provide confidence limits. Stratified random quadrat surveys are another method used to estimate forest-dwelling caribou numbers

(Gasaway *et al.* 1986); in contrast to minimum counts, confidence limits around the subpopulation estimates are produced. Distance sampling (Nielsen *et al.* 2006) has also been used for the Carcross subpopulation in Yukon (Environment Yukon, unpublished data). For some subpopulations, the only estimates available are based on sightings of caribou during surveys conducted for other species (e.g. Thiessen 2009). In addition to population surveys, fall composition surveys are conducted to determine age/sex ratios (e.g. Young and Freeman 2001, McNay *et al.* 2010, Kerckhoff 2013, BC MFLNRO unpublished data, Environment Yukon unpublished data). For the Bonnet Plume and Redstone subpopulations, fall composition is based on hunter observations that have been collected since 1991 (Larter 2012).

Population size and trend data are limited for the Northern Mountain DU. Only one estimate is available for 18 of 45 subpopulations; some early surveys for the other subpopulations did not always include all of the range and are not comparable to more recent estimates (Appendix 2). The most consistently surveyed subpopulation has been the Itcha-Ilgachuz subpopulation in west-central BC, which was surveyed almost every year from 1978 to 2003 and then on average every 2 years afterwards (Young and Freeman 2001, BC MFLNRO, unpublished data). For that subpopulation, population surveys are conducted in June when most of the females are in the alpine zone and supplemented with fall composition data (Young and Freeman 2001).

Abundance and Trends

About 50 000 - 55 000 caribou occur in the Northern Mountain DU, of which there are an estimated 43,443 to 47,752 mature individuals (Table 1; Appendix 2). These animals account for about 95% of western mountain caribou in Canada. Although most of the subpopulation estimates have been derived from surveys, 29 of the 45 estimates are already over 5 years old or based solely on expert opinion, and may not reflect the current status. Over half (26 of 45) of the subpopulations contain more than 500 mature individuals, while 13 subpopulations contain fewer than 250 (Table 1). Nine of the 15 subpopulations that consist of more than 1000 mature individuals are located in Yukon and NT. Combined, the Bonnet Plume and Redstone subpopulations, the two largest in the DU, comprise >15 000 animals, or 26-29% of the Northern Mountain DU. The four subpopulations that consist of fewer than 50 mature individuals are located in the southern part of the DU in west-central BC (Charlotte Alplands, Rainbows, Telkwa) and northeastern BC (Finlay).

Table 1. Trends and numbers of mature individuals within the past 3 generations in subpopulations in the Northern Mountain DU 9 (see subpopulation survey estimates compiled in Appendix 2).

Subpopulation	3 generations (27 years)[1]																											% Change	Most recent estimate	Current trend[1,2]	Population management
	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013				
Northwest Territories/Northern Yukon																															
Hart River																				X									1853	U	
Clear Creek															X														801	U	
Bonnet Plume	O																												4200	=[3]	
Redstone																										X			7300-10000	=[4]	
South Nahanni																							X					+10%[5]	1886	=	
Coal River																						X							413	U	
La Biche							X																						388	U	
Southwest Yukon																															
Chisana																								X				-3%	587	=	Captive rearing 2003-2006; Closure of licensed and First Nation (voluntary) harvest, mid-1990s to present
Kluane																							X					-23%	163	↓	Wolf removal and sterilization on adjacent Aishihik subpopulation 1993-1997[6]; Closure of licensed and First Nation (voluntary) harvest, mid-1990s to present
Aishihik																							X					+30%	1813	↑	Wolf removal and sterilization 1993-1997[6]; Currently under a permit-based licensed harvest
Klaza																										X			1065	U	Wolf removal and sterilization on adjacent Aishihik subpopulation 1993-1997[6]; Currently under a permit-based licensed harvest
Central Yukon																															
Ethel Lake							X																						289	U	Voluntary harvest closure
Moose Lake					X																								270	U	
Tay River					X																								2907	U	
Tatchun														X															415	U	
Pelly Herds																X													876	U	
Finlayson																					X							+13%[7]	2657	↓	Wolf removal 1983-1989; Currently under a permit-based licensed harvest

Subpopulation	3 generations (27 years)[1]																											% Change	Most recent estimate	Current trend[12]	Population management
	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013				
Wolf Lake												X																-[8]	1240	U	
Southern Lakes Yukon																															
Laberge[9]																	X												176	U	
Ibex																						X						+127%	748	↑	Closure of Yukon licensed and First Nation (voluntary) harvest, mid-1990s to present
Carcross[9]																					X							+116%	674	=	Closure of Yukon licensed and First Nation (voluntary) harvest
Atlin[9]																					X							-2%	514-857	=	Closure of Yukon licensed and First Nation (voluntary) harvest
Northwest BC																															
Swan Lake[9]																					X								515-686	U	
Little Rancheria[9]													X																672-1342	U	
Horseranch[9]														X															680-850	U	Wolf removal 1977-1980, 1985
Level Kawdy												X																	1239	U	
Edziza																				X									140	U	
Tsenaglode																						O							85-340	U	
Spatsizi								X																					2258	U	
Northeast BC																															
Liard Plateau[9]																								X				+15%	140	↓[10]	
Rabbit																					X								1095	U	Wolf removal 1982-1985
Muskwa																					X								828	U	Wolf removal 1984,1985, 1987
Gataga														X															220	U	
Frog															X														199	U	
Finlay																X												-89%	19	↓	
Pink Mountain							X																						1145	U	
North-central BC																															
Graham																							X					-[11]	637	=	
Chase																							X						404	U	
Wolverine																								X				-9%	298	U	
Takla																		X											98	U	
West-central BC																															
Telkwa																											X	-64%	19	↓	Augmented 1997-1999[12]
Tweedsmuir																X												-47%[13]	248	↓	
Itcha-Ilgachuz																										X		+81%[14]	1220	↓	
Rainbows																						X						-53%	43	↓	

Subpopulation	3 generations (27 years)[1]																											% Change	Most recent estimate	Current trend[1,2]	Population management
	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013				
Charlotte Alplands							▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	X		-84%	6	↓	Transplants 1984-1991[15]
Total																													43,443-47,752		

[1] Coloured bars represent the population trend time frame for 3 generations (orange indicates a declining trend, green indicates an increasing trend, yellow indicates a stable trend, grey indicates an unknown trend) based on available survey estimates (see Appendix 2 for details on years and numbers). The symbols "X" and "O" represent the most recent survey/estimate; X = estimate based on a survey; O = estimate based on expert opinion

[2] Current trend from interviews with regional biologists

[3] Current trend based on 16% calves (average 1991-2010) during fall hunter observations (Larter 2012); most recent population estimate is from 1982

[4] Current trend based on 27% calves (average 1991-2010) during fall hunter observations (Larter 2012)

[5] % change in population size based on 1337 mature individuals in 2001 and 1465 mature individuals in 2009 for an area comparable to the 2001 survey area

[6] Wolf removal was conducted 1993-1997 and wolf sterilization was conducted 1994-1997 (Hayes *et al.* 2003)

[7] Although the net change from 1986 to 2007 was a net increase of 13%, the population increased from 2350 mature individuals in 1986 to 4474 in 1990, and then decreased to 2657 by 2007 (a 41% decline from its peak in 1990 to 2007)

[8] No recent population estimate so the 3 generation % change was not calculated

[9] The ranges of the Carcross, Atlin, Swan Lake, Little Rancheria, Horseranch and Liard Plateau subpopulations straddle the Yukon/BC border. Altin was named Atlin East, and Carcross and Laberge were Atlin West in COSEWIC (2002). Swan Lake was called Jennings in 2002.

[10] The current declining trend is based on 2 recent years of poor calf recruitment in March (7% in 2011, 4% in 2012; McNay and Giguere 2013)

[11] Absolute % change not possible to assess since the total survey area varied between surveys

[12] Augmented with 12 caribou in late winter 1997 and 20 caribou in winter 1998/99. Although the overall decline is 46%, the population peaked in 2006 after augmentation and has declined 58% since then. The current population level is much lower than the peak number counted (222 adults) in 1965

[13] The decline is supported by an average λ of 0.947 for 12 years where data was available during the period 1985/86 to 2008/09 (Cichowski and MacLean 2005, Cichowski 2010)

[14] Although the net change from 1987 to 2012 was a net increase of 81%, the population increased from 675 mature individuals in 1987 to 2161 in 2003, and then decreased to 1220 by 2012 (a 44% decline from its peak in 2003 to 2012)

[15] In November 1984, 15 caribou were transplanted from the Itcha-Ilgachuz subpopulation to unoccupied habitat in the Charlotte Alplands. An additional 15 caribou were transplanted in 1986, 11 in 1987, 3 in 1988 and 8 in 1991.

Trend data are even more limited for this DU than population size data: Long-term (three-generation) trend is known for only 15 of 45 subpopulations and more recent trends are available for 18 subpopulations (Table 2). Over the last three generations, the best available information (including expert opinion in many cases) indicates that 4 subpopulations have increased, 5 remained stable, and 6 have decreased. Current trends indicate that 2 subpopulations are increasing, 7 are stable and 9 are decreasing. The 2 currently increasing and 6 of the 7 currently stable subpopulations are located in the northern part of the DU in Yukon and NT and along the Yukon/BC border. The Kluane and Finlayson are the only 2 subpopulations known to be declining in Yukon. The Finlayson subpopulation increased in the late 1980s during wolf removal efforts, but has been decreasing since that program ended. The Aishihik subpopulation decreased from the early 1980s until the 1990s but started increasing during wolf removal efforts in the mid-1990s, and has continued to increase. Members of the Champagne and

Aishihik First Nation in the southwestern Yukon began noticing a decline in the Aishihik caribou subpopulation in the 1980s, which was believed to have resulted from increased predation and overhunting (Hayes and Couture 2004).

Table 2. Frequency distribution of long-term and recent trends for caribou subpopulations in the Northern Mountain, Central Mountain and Southern Mountain Designatable Unit (DUs) in 2013.

Trend in numbers	Northern Mountain (DU7)		Central Mountain (DU8)		Southern Mountain (DU9)	
	Long-term[1]	Recent[2]	Long-term[1]	Recent[2]	Long-term[1]	Recent[2]
Increase	4	2	0	0	1	1
Stable	5	7	0	0	0	3
Decrease	6	9	11	10	16	11
Unknown	30	27	1	0	0	0
Extirpated	0	0	0	2	0	2
Total	45	45	12	12	17	17

[1] Long-term trend (over 3 generations) includes extirpated subpopulations

[2] Recent trend as reported by jurisdictions

Average annual calf recruitment for 6 of 10 subpopulations with 3 or more years of late winter calf recruitment data is less than the 15% rate recommended by Bergerud (1996) to achieve population stability (Table 3). For the Itcha-Ilgachuz subpopulation, although the average recruitment rate is 18%, most data are from before 2001 when numbers were increasing; the most recent recruitment estimate for that subpopulation is 8% (Davis 2013). Calf recruitment based on hunter observations collected in the fall from 1991-2010 averaged 16% (range: 11-21%) for the Bonnet Plume subpopulation and 27% (range: 21-34%) for the Redstone subpopulation (Larter 2012). Because some mortality likely occurs over winter, the Bonnet Plume subpopulation may also have late winter calf recruitment of less than 15%.

Table 3. Late winter calf recruitment for subpopulations with data in the Northern Mountain DU(7).

	Recruitment rate (% calves)		Years sampled		
Subpopulation	Average	Range	Period	N	Source
Atlin	14	7-20	1995-2007	7	Florkiewicz 2008
Swan Lake	17	14-23	2006-2008	3	BC MFLNRO unpublished data
Little Rancheria	15	10-19	1997-2001	5	BC MFLNRO unpublished data
Horseranch	12	7-17	1997-2001	5	BC MFLNRO unpublished data
Muskwa	14	12-16	2001-2003	3	Tripp *et al.* 2006
Chase	15	12-18	1993-2010	8	McNay *et al.* 2010
Wolverine	14	7-24	1989-2010	11	McNay *et al.* 2010
Tweedsmuir	11	6-19	1986-2009	15	Cichowski and MacLean 2005 Cichowski 2010
Itcha-Ilgachuz	18	8-28	1977-2004; 2013-2014	19	Young and Freeman 2001 Davis 2013; BC Ministry of Environment unpublished data
Rainbow	10	3-15	1996-2001	6	Young and Freeman 2001

All 5 subpopulations in west-central BC (Telkwa, Tweedsmuir, Itcha-Ilgachuz, Rainbows, Charlotte Alplands) are currently declining. The west-central BC subpopulations are isolated from other subpopulations in this DU and in neighbouring DUs by the interior plateau. Although the current estimate of 1220 mature individuals in Itcha-Ilgachuz subpopulation (the largest subpopulation in west-central BC) is higher than the 1987 estimate of 730, the population increased to a peak of 2161 mature individuals in 2003 then underwent a 44% decline between 2003 and 2012 (Table 1, Appendix 2). The Telkwa subpopulation in west-central BC was augmented with 32 caribou from the Chase subpopulation from 1997 to 1999. That subpopulation increased following the transplants to a peak of 66 mature individuals in 2006 before declining to the current estimate of 19. From 1984 to 1991, 52 caribou from the Itcha-Ilgachuz subpopulation were transplanted to an unoccupied part of the Charlotte Alplands range (Young *et al.* 2001). That subpopulation appeared to remain stable until about 1999 but then declined. Monitoring programs for both the Telkwa and Charlotte Alplands subpopulations following translocations ended around the time of their post-translocation population peaks, so it is unknown why they declined. The Telkwa subpopulation was at its highest recorded level in the mid-1960s when 271 caribou (222 mature individuals) were counted in the Telkwa range in March 1965 (Theberge and Oosenbrug 1977). ATK attributes the decline of the Telkwa subpopulation in the 1960s and 1970s to railroad construction and disturbance, mining exploration, and helicopter hunting (Stronen 2000).

The estimated number of mature individuals in the former Northern Mountain population of Woodland Caribou was 43,950 in 2002 (COSEWIC 2002). Of the 45 current subpopulations making up the Northern Mountain DU, 36 subpopulations fell within the former Northern Mountain population and are currently estimated at 40,470 – 44,779 (Table 1). This compared to the 43,950 which was estimated for these individuals in 2002. Although there is considerable uncertainty around both estimates, this suggests an overall stable situation. On the other hand, the 9 subpopulations at the southern part of the DU, all of which belong to the former Southern Mountain population of Woodland Caribou (Environment Canada 2014) have experienced an overall decline of 27%, from 4,075 to 2,973 mature individuals. Five subpopulations have decreased by over 20%, one has increased, and two have remained relatively stable (Table 1).

Population viability analyses (PVAs) were conducted for two of the declining subpopulations: Itcha-Ilgachuz and Tweedsmuir-Entiako (Hatter and Young 2004, Cichowski and MacLean 2005, Griffiths 2011). The purpose of the PVA for the former was to evaluate how translocations out of the subpopulation and hunting would affect caribou numbers, and the subpopulation was predicted to continue to increase with or without translocations and hunting (Hatter and Young 2004). More recently, Griffiths (2011) used 3 models for the same subpopulation. A continued growth and dispersal model predicted the subpopulation to increase with or without translocation, whereas a predation model predicted the subpopulation to decrease to about 1,000 caribou within 10 years (by 2020) with or without removals. The Tweedsmuir-Entiako PVA predicted that in 20 years the subpopulation would decline by 50% using bull survival data from the subpopulation (based on a low sample size), or decline by 70% assuming a more typical bull mortality rate (Cichowski and MacLean 2005).

Central Mountain DU (8)

Sampling Effort and Methods

For those subpopulations that use alpine or subalpine habitat in late winter, aerial surveys are conducted in alpine and subalpine parkland habitat and the proportion of radio-collared caribou is used to correct for the total number of animals in the survey area but not seen, to provide a survey estimate, and to correct for animals not present in the survey area to provide a population estimate (Seip and Jones 2013). Survey estimates are used to track population trends over time because they are based on a standard survey area. For the Tonquin, Maligne, and Brazeau subpopulations, surveys are conducted during fall when caribou are in alpine habitat. Recently, techniques using DNA analyses of fecal pellets (Hettinga 2010) have also been used to estimate the size of the Tonquin, Maligne and Brazeau subpopulations (L. Neufeld, pers. comm. 2013). No formal censuses have been conducted for the Scott, Narraway, A La Peche, or Redrock-Prairie Creek subpopulations.

In addition to formal surveys, trends in relative abundance for some subpopulations are monitored using mortality rates of radio-collared caribou and recruitment rates of all caribou seen during searches for radio-collared caribou during late winter (ASRD&ACA 2010, Seip and Jones 2013). The number of caribou counted during recruitment surveys has also sometimes been used as a minimum count when assessing declines (Seip and Jones 2013). Mortality rates of radio-collared caribou and late winter calf recruitment rates have been tracked every year since 1998/99 for the Redrock-Prairie Creek and A La Peche subpopulations, 2002/03 for the Moberly, Burnt Pine, Kennedy Siding, and Quintette subpopulations, 2003/04 for the Tonquin, Maligne, and Brazeau subpopulations, and 2005/06 for the Narraway subpopulation (ASRD&ACA 2010, Seip and Jones 2013, AESRD unpublished data).

Abundance and Trends

The current estimate for the Central Mountain DU population is 469 mature individuals (Table 4; Appendix 3). All 10 extant subpopulations are estimated to contain fewer than 250 mature individuals, with 4 among them fewer than 50 (Tables 2, 4). In addition, the Banff subpopulation was confirmed extirpated in 2009 (Hebblewhite *et al.* 2010b), and the Burnt Pine subpopulation was confirmed extirpated in 2014 (BC Ministry of Environment, unpublished data). The overall decline in the Central Mountain DU population was 64% during the last 27 years (3 generations) and 62% during the last 18 years (2 generations; Table 4). All subpopulations have experienced long-term declines of at least 29% and are currently known to be in continuing decline, except for the Scott subpopulation where the trend is unknown (Table 2). The decrease in numbers seen during surveys is supported by consistently high adult mortality and low calf recruitment (Seip and Jones 2013, ASRD&ACA 2010).

Table 4. Percent change in number of mature individuals within the past 3 generations and 2 generations in the Central Mountain DU (see Appendix 3 for details on survey information).

Subpopulation	3 generations (27 years)[1]																												% change (number of generations)		Current	
										2 generations (18 years)[1]																						
	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	(3)	(2)	Estimate	Trend[1]
Scott[2]																					▨	▨	▨	▨	▨	▨	▨	▨	Unk	Unk	35	U
Moberly[2]									▒	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	-89	-89	18	↓
Kennedy Siding																					▨	▨	▨	▨	▨	▨	▨	▨	-72	-72	29	↓
Burnt Pine[2]										▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	-100	-100	0	↓
Quintette[3]																						▨	▨	▨	▨	▨	▨	▨	-41	-41	87	↓
Narraway[4]																						▨	▨	▨	▨	▨	▨	▨	-52	-52	78	↓
Redrock-Prairie Creek													▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨			-71	-71	106	↓
A La Peche													▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨			-29	-29	75	↓
Jasper (3 subpops)[5]			▒	▒	▒	▒	▒	▒	▒	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨		-72	-54	41	↓
Banff	▒	▒	▒	▒	▒	▒	▒	▒	▒	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨						-100	-100	0	X
TOTAL	▒	▒	▒	▒	▒	▒	▒	▒	▒	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	-64	-62	469	↓

[1] Coloured bars as in Table 1 (see Appendix 3 for details on years and numbers). Current trend is from interviews with regional biologists.

[2] Burnt Pine, Moberly and Scott all considered as Moberly subpopulation in COSEWIC (2002).

[3] The current population estimate for the Quintette subpopulation (119) differs from the survey estimate of 92 from that survey. The population estimate was used in the total DU population estimate, but the survey estimate was used when calculating trend (see Seip and Jones 2013).

[4] Narraway was named Belcourt in COSEWIC (2002)

[5] Jasper recognized as three subpopulations: Tonquin, Maligne, and Brazeau.

First Nations community members in west-central Alberta feel that the decline of caribou and their habitat is due to increased industrial activity, increased recreation including all terrain vehicle (ATV) use, and past mortality due to vehicle collisions on Highway 40 (West Central Alberta Caribou Landscape Planning Team 2008). The West Moberly First Nation attributes the decline and eventual loss of the Burnt Pine subpopulation to cumulative impacts including forest harvesting (habitat loss alteration, and habitat fragmentation and functional habitat loss), industrial development, and the construction of the WAC Bennett Dam on the Peace River, which created and flooded the Williston Reservoir (West Moberly First Nations v. British Columbia 2011).

All 12 subpopulations in the new Central Mountain DU considered in this report belonged to the former Southern Mountain population of Woodland Caribou (Environment Canada 2014). The corresponding subpopulations were estimated at 1,293 mature individuals in 2002 (COSEWIC 2002), all subpopulations have declined, and two have been extirpated. Only one (Banff) numbered fewer than 50 individuals at the time of this last assessment.

DeCesare *et al.* (2011) conducted PVAs to assess the effects of translocations on the 3 subpopulations in Jasper Park, and the extirpated Banff subpopulation. The Brazeau and Maligne subpopulations are likely to become extirpated within 20 years without translocation, and translocation may reduce the short-term risk of extinction, but may not be sufficient to reverse the declines unless vital rates are improved naturally or through additional conservation actions (DeCesare *et al.* 2011). The Tonquin subpopulation appeared viable over the next 20 years (based on a quasi-extinction threshold of 8 females) even without translocation.

Based on observed calf recruitment and adult female mortality rates, Smith (2004) predicted that the Redrock-Prairie Creek subpopulation would decline by 20% and the A La Peche subpopulation would increase over the next 20 years. He also predicted that increasing the density of roads or cutblocks would exacerbate the decline of the Redrock-Prairie Creek subpopulation and that increasing cutblock density to 7.2 ha/km^2 or increasing road density by 120 m/km^2 would result in a ≥20% decline for the A La Peche subpopulation over the next 20 years. Wilson (2012) predicted that a status quo management scenario would result in the extirpation of the Burnt Pine, Moberly, and Kennedy Siding subpopulations and declines of >20% for the Narraway and Quintette subpopulations over the next 20 years.

Southern Mountain DU (9)

Sampling Effort and Methods

In the Southern Mountain DU, aerial surveys conducted shortly after a fresh snowfall in late winter provides the best time to obtain unbiased estimates of population size and structure (Seip 1990). Subalpine areas are searched for caribou, and if tracks are seen, they are followed until the caribou are found. When present, radio-collars are used to correct for caribou not seen, or not present in the survey area; otherwise, a standardized sightability correction factor based on the proportion of caribou estimated to have been counted during the survey (83%; Seip 1990, Young and Roorda 1999) is applied to the total counted to estimate population size (Resources Inventory Committee 2002). Survey effort has varied among subpopulations. The earliest available surveys are for the Barkerville, Wells Gray (south), and Groundhog subpopulations from the late 1980s (Seip 1990, Hatter 2006, Freeman 2012). The Quesnel Highlands portion of the Wells Gray (north) subpopulation (Seip 1990) and portions of some of the subpopulations in the Revelstoke area (see McLellan *et al.* 2006) were also censused in the late 1980s, but areas surveyed did not cover whole ranges. During the 1990s, at least 2 surveys were conducted for most subpopulations (Hatter 2006) and surveys were conducted in most years for the Barkerville, Wells Gray (north), Central Purcells, South Purcells, and South Selkirk subpopulations (Wakkinen 2003, Kinley 2007, Freeman 2012). Since 2002, most subpopulations have been surveyed approximately every second year.

Abundance and Trends

Spalding (2000) and McLellan (2009) both reported observations of >100 individuals in a group including some groups of >1000 individuals from early in the 1900s. Today, the number of caribou in the Southern Mountain DU is estimated at 1395 mature individuals (Table 5; Appendix 4). Of the 15 extant subpopulations, all consist of fewer than 500 mature individuals and only two have more than 250. Nine subpopulations number fewer than 50 mature individuals, and six of those subpopulations contain fewer than 15 animals. Two subpopulations were recently extirpated: the George Mountain subpopulation in 2003 and the Central Purcells in 2005. All subpopulations experienced declines during the last 27 years (3 generations) and 18 years (2 generations), except for the Barkerville subpopulation, which has increased (Table 5). Recent trends indicate that 1 subpopulation is currently increasing, 3 are stable, and 11 are decreasing (Table 2). The overall decline rate of the Southern Mountain population was 45% within the last 27 years, and 40% within the last 18 years. However, these decline estimates likely underestimate the actual decline, as the earlier surveys used for estimating the size of some subpopulations were more recent than the two or three generation timeframe.

Table 5. Percent change in number of mature individuals within the past 3 generations and 2 generations in the Southern Mountain DU (see Appendix 4 for details on survey information).

Subpopulation	3 generations (27 years)[1]																												% change (number of generations)		Current		Population management
										2 generations (18 years)[1]																							
	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	(3)	(2)	Estimate	Trend[1]	
South Selkirks									░	░	░	░	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	-62	-60	20	↓	augmented 1988-1998[2]
Purcells South									░	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	-65	-61	22	=	augmented 2012[3]
Purcells Central[9]								░	░	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨										-100	-100	0	X	augmented 2012[4]
Nakusp[10]										▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	-72	-72	54	↓	
Duncan[10]													▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨			-91	-91	2	↓	
Central Rockies									░	░	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨							-86	-83	4	↓	
Monashee								░	░	░	░	░	░	░	░	░	░	▨	▨	▨	▨	▨	▨	▨	▨				-50	-43	4	↓	augmented 1985[5]
Frisby Boulder[11]								░	░	░	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨		-69	-68	12	↓	moose reduction 2003-pres[6]
Columbia South[11]								░	░	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨		-94	-93	6	↓	moose reduction 2003-pres[6]
Columbia North[11]											▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨		-36	-36	157	=	moose reduction 2003-pres[6]
Groundhog[11]				░	░	░	░	░	░	░	░	░	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨		-87	-56	11	↓	
Wells Gray									░	░	░	░	░	░	░	░	░	░	░	▨	▨	▨	▨	▨	▨	▨	▨		-43	-26	341	↓	wolf sterilization 2001-2012[7]
Barkerville		░	░	░	░	░	░	░	░	░	░	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨			+94	+90	78	↑	wolf sterilization 2001-2012[7]
North Cariboo Mtns													▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨				-28	-28	202	↓	
Narrow Lake													▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	-38	-38	45	=	
George Mountain							░	░	░	░	░	░	▨	▨	▨	▨	▨												-100	-100	0	X	
Hart Ranges																				▨	▨	▨	▨	▨	▨	▨	▨		-35	-35	398	↓	moose reduction 2006-pres[8]
TOTAL		░	░	░	░	░	░	░	░	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	▨	-45	-40	1356	↓	

[1] Coloured bars as in Table 1 (see Appendix 4 for survey details). Current trend is from interviews with regional biologists

[2] Augmented with 60 caribou from 1988 to 1990, and 43 caribou from 1996 to 1998 (Compton *et al.* 1995, Wakkinen 2003)

[3] Augmented with 10 caribou in March 2012; all transplanted caribou confirmed dead except 2 with failed collars (L. de Groot, pers. comm. 2013)

[4] Augmented with 9 caribou in March 2012; all transplanted caribou died or left the area and died (L. de Groot, pers. comm. 2013)

[5] Augmented with 9 caribou in winter 1984/85 (Wahl 1988).

[6] Liberalized moose hunting from 2003 to present resulting in a 71% reduction of moose and ~50% reduction in wolves (Serrouya 2013)

[7] Wolf sterilization/removal conducted 2001-2004 and 2007-2012; moose reduction through liberalized harvest conducted 2001-2011 (Roorda and Wright 2012, Hayes 2013); population management actions limited to the Barkerville subpopulation and Wells Gray North portion only of the Wells Gray subpopulation

[8] Moose reduction through liberalized harvest conducted 2006 to present in the Parsnip portion of the Hart Ranges only (D. Heard, pers. comm. 2013)

[9] Purcells Central considered part of Purcells South range in COSEWIC (2002)

[10] Naskup and Duncan equivalent to Central Selkirks in COSEWIC (2002)

[11] Columbia South, Groundhog, Frisby-Boulder, and Columbia North all part of Revelstoke range in COSEWIC (2002)

The South Selkirk subpopulation, shared with Idaho and Washington, received transplants totalling 60 caribou from 1987 to 1990 (Compton *et al.* 1995) and an additional 43 from 1996 to 1998 (L. de Groot, pers. comm. 2012). Source animals from 1987 to 1990 were from Revelstoke and Itcha-Ilgachuz subpopulations, and from 1996 to 1998 from Wells Gray (north) and North Cariboo Mountains (Zittlau 2004). In March 2012, 19 caribou were transplanted from the Level-Kawdy subpopulation in the Northern Mountain DU to the South and Central Purcell ranges in the Southern Mountain DU (L. de Groot, pers. comm. 2013). Seventeen died within months, and the fate of the remaining two is unknown due to radio-collar malfunction (L. de Groot, pers. comm. 2013).

All 17 subpopulations in the new Southern Mountain DU considered in this report belonged to the former Southern Mountain population of Woodland Caribou (Environment Canada 2014). The corresponding subpopulations were estimated at 1,850 mature individuals in 2002 (COSEWIC 2002), a 27% decline. All but one subpopulation (Barkerville) have declined, two have been extirpated, and five numbered fewer than 50 individuals at the time of the last assessment vs. 9 today.

Wittmer *et al.* (2010) used stochastic projection models on 10 subpopulations of Southern Mountain DU caribou. All 10 were predicted to decline to extinction within <200 years when models incorporated the declines in adult female survival known to occur with increasing proportions of young forest and declining population densities. All but two had a cumulative probability of extinction of > 20% (24-100%) within 45 years (5 generations). Increases in the amount of young forests resulted in faster extinction rates in all populations. Hatter (2006) conducted PVAs for all extant 15 subpopulations in this DU based on population surveys. Time to quasi-extinction (N<20 animals) was less than 50 years for 10 of 15 subpopulations. The probability of quasi-extinction in 20 years was >20% for 12 of 15 subpopulations and >50% for 13; however, Hatter (2006) cautions that confidence limits indicate a low level of confidence for 5 of the subpopulations that have a high probability of extinction. By contrast, the largest subpopulations—North Caribou and Hart Ranges—were identified in both studies as having zero or low probabilities of extinction in this time period.

Summary

Both the Southern Mountain and Central Mountain DUs have experienced pronounced population declines within the last 27 years. The overall decline in the Central Mountain DU population was 64% during the last 27 years (3 generations) and 45% for the Southern Mountain population during the same time period. The only subpopulation in those two DUs that has increased has been the Barkerville subpopulation (Southern), likely benefiting from a recent wolf sterilization and removal program (Roorda and Wright 2012). However, it still consists of fewer than 100 mature individuals (Table 5). Several recognized subpopulations in the 2002 assessment from these DUs have since split into multiple subpopulations as a result of cessation of dispersal within ranges. Less information is available on subpopulation size and trend in the Northern Mountain DU but the two largest subpopulations making up about 24% of the overall population are found in Yukon and NT, while 9 subpopulations located in the southern portion of the DU in west-central and north-central BC have experienced a 27% decline since 2002.

Most ATK is in agreement that caribou subpopulations have seen a steady decrease since the early 1900s with arrival of moose and the increase of wolves in the 1930s. As habitat loss and caribou predation increased, caribou numbers started to decline starting in the 1940s, either as actual population decline or by migration northwards. Prior to the 1900s, caribou were described as blackening a mountainside (Meska or Too-Dinie Mountains). Others have noted that previous caribou territory has now been abandoned (Takla Lake area and Mount Milligan; McKay 1997, Tsilhqot'in Nation v. British Columbia 2007, McNay *et al.* 2008).

Rescue Effect

Rescue effect from natural dispersal is unlikely for the Southern Mountain DU. The nearest subpopulation in the US is the South Selkirk subpopulation, which is shared between BC, Idaho, and Washington, and currently consists of only 28 mature individuals. Even within the Southern Mountain DU, subpopulations are effectively isolated from one other with almost no evidence of movement between them except at the northern extent of the DU (van Oort *et al.* 2011). The closest DU is the Central Mountain and Northern Mountain DU, but these animals are not only declining in most neighbouring subpopulations but are adapted to living in shallow snow environments and will likely encounter difficulty adjusting to deep snow conditions. The same characteristics that render all three mountain caribou DUs as discrete and significant relative to neighbouring caribou subpopulations (see **Designatable Units**; COSEWIC 2011) make the prospects for rescue highly unlikely.

There may be some potential for rescue of the Northern Mountain DU from neighbouring Alaska subpopulations. Chisana caribou are found in Alaska and Yukon and have occasionally overlapped with the Nelchina and Mentasta subpopulations in Alaska (T. Hegel, pers. comm. 2013). However, Alaska subpopulations have not been evaluated within the COSEWIC DU framework to evaluate the similarity with Northern Mountain DU subpopulations in Canada. The Central Mountain DU is endemic to Canada, so there are no outside subpopulations available for rescue.

THREATS AND LIMITING FACTORS

Direct threats facing mountain caribou assessed in this report were organized and evaluated based on the IUCN-CMP (World Conservation Union-Conservation Measures Partnership) unified threats classification system (Master *et al.* 2009). Threats were defined as the proximate activities or processes that directly negatively affect western mountain caribou. These were assessed separately for each of the three DUs, with results on the impact, scope, severity and timing of each presented in tabular form in Appendix 5 (Southern Mountain Caribou), Appendix 6 (Central Mountain Caribou) and Appendix 7 (Northern Mountain Caribou).

The overall calculated and assigned threat impact is Very High for both Southern and Central Mountain caribou and High for Northern Mountain caribou. Although the large majority of the direct impact is from predation, multiple additional threats are evident. This underscores the cumulative nature of threats, which are not only additive in nature, but also synergistic. When integrated across a seasonal range, many small events from different threat sources can have a large overall impact on a caribou population. These cumulative impacts are not well represented by the threats calculator, which is oriented to identifiable events within discrete threat categories, many of which have low direct impacts by themselves. In addition, multiple subpopulations, particularly in the Central and Southern Mountain DUs, are severely limited by small population sizes (< 50 mature individuals).

Narrative descriptions of the threats are provided below in the general order of highest to lowest overall direct impact for all designatable units, although each threat does not have the same overall impact on either the three DUs or individual subpopulations within each DU. This is followed by a discussion of the geography of threats acting within each DU. Many threats and limiting factors interact with one another.

Predation (IUCN Threat #8.2: Problematic native species)

The highest-impact and most immediate threat to all three western mountain caribou DUs is increased predation that results from large-scale habitat alterations arising from cumulative industrial and natural (fire, insect, windthrow) disturbances. Although forest harvesting and mineral and hydrocarbon exploration and development do not generally result in substantial direct mortality of western mountain caribou (see **Industrial Development activities**), habitat changes arising from these activities and associated infrastructure affect the abundance, habitat use and movements of both predators and alternate prey (Festa-Bianchet *et al.* 2011, Serrouya *et al.* 2011). Predation is directly related to increased prey populations that show a numerical and distribution response to early seral forest resulting from cumulative development activities.

Wolves are the primary predator of caribou in the three DUs (Edmonds 1988, Farnell and McDonald 1988, Seip 1992b, Hayes *et al.* 2003, McNay 2009, Whittington *et al.* 2011). Bears, cougars, and wolverine can also be locally and/or seasonally important sources of predation (Kinley and Apps 2001, Cichowski and MacLean 2005, Wittmer *et al.* 2005b, Gustine *et al.* 2006a, McNay 2009, Milakovic and Parker 2013). Although predation is the primary cause of mortality (Edmonds and Smith 1991, Seip 1992b, Wittmer *et al.* 2005b), caribou are usually a secondary prey species in the diets of predators, whose populations are sustained by other prey species such as moose and deer (Seip 1992b, Stotyn 2008, Williamson-Ehlers 2012). While caribou and other prey do not compete directly for resources, other prey affect caribou populations through 'apparent competition', which is the indirect interaction between species when they share a common predator. This interaction generally leads to caribou declines when other prey species increase in numbers (Holt 1984, Wittmer *et al.* 2007, DeCesare *et al.* 2009).

Historically, predator-prey dynamics on forest-dwelling caribou ranges have fluctuated with environmental conditions and management practices. Moose were largely absent, or present at extremely low densities, in southern and central BC until the late 1800s when they expanded out from refugia in western Canada (Santomauro *et al.* 2012). ATK indicates that moose were first observed in north-central BC around 1914-1921, that wolf numbers increased since about 1938, and that caribou were disappearing by the 1940s (McKay 1997, Santomauro *et al.* 2012), while in west-central BC, moose began colonizing the Bulkley Valley in the 1920s (Stronen 2000). Carrier (Tsay Keh Dene) and Sekani (Kwadacha) First Nations ATK holders describe an increase in "… the abundance of wolves and their more persistent presence throughout the year following the first appearance of moose in the early 1920s" (McKay 1997, McNay *et al.* 2008). Some relatively large populations of caribou were recorded in the late 1960s and early 1970s (Bergerud 1978) following a period in the 1950s and 1960s when wolves and coyotes were poisoned through wide-scale predator control programs (Cringan 1957, Bergerud 1978, Edmonds and Bloomfield 1984, Edmonds 1988, Bergerud and Elliott 1998). Large legal hunting of caribou in BC and Alberta (Bergerud 1978, Edmonds and Bloomfield 1984) combined with recovering wolf populations and adverse weather probably caused caribou population declines in the 1970s.

Western mountain caribou are generally spatially separated from predators and other prey through most of their annual cycle (Seip 1992a, Stotyn 2008, Hebblewhite *et al.* 2010a, Steenweg 2011, Robinson *et al.* 2012). In the Southern Mountain DU, spatial separation is greatest during late winter when caribou are found in subalpine forests and wolves, cougars, moose, and deer inhabit valley bottoms; the lowest degree of spatial separation occurs during spring (Seip 1992a, Stotyn 2008, Steenweg 2011). At the broad scale, wolf predation on caribou occurs primarily at low elevations, with mortality risk influenced by habitat changes beyond those areas occupied by caribou, i.e., within the winter ranges of alternative ungulate prey that stimulate population-level numerical responses of predators (Apps *et al.* 2013). In the Central Mountain DU, caribou select higher elevations and forested habitats and avoid burns, while wolves select burns, areas close to burns, and open habitats and avoid high-elevation/alpine areas (Gustine and Parker 2008, Hebblewhite *et al.* 2010a, Robinson *et al.* 2010; Williamson-Ehlers 2013). Farnell (2009) argued that the spatial separation model does not fit the Yukon system because caribou use space that overlaps with moose all year around, except possibly in summer. During calving, caribou spatially separate themselves from other prey and predators by dispersing into high-elevation alpine and subalpine habitat (where forage is limited) or onto islands in lakes where predators are less abundant (Bergerud *et al.* 1984, Bergerud 1985). In west-central BC, caribou that calve in mountains or on islands have higher neonatal survival than those that calve in low-elevation forests (Seip and Cichowski 1996, Cichowski and MacLean 2005).

Most ATK holders agree that predation is dynamic and somewhat complex; however, they have observed that habitat alteration has allowed other ungulates to move into former caribou territory, which has led to an increase in bear and wolf populations, with increased caribou predation (McKay 1997, Stronen 2000, Hayes and Couture 2004, Littlefield *et al.* 2007, Tsilhqot'in Nation v. British Columbia 2007, McNay *et al.* 2008). While caribou do not compete with other ungulates for forage and are spatially separated from them, ATK notes that predation is a year-round pressure on caribou, brought about through a multifaceted interaction among caribou, wolves, and moose. When levels of landscape disturbance are high, moose move into these areas, wolves move with them and then prey on caribou. Elders have noticed that predation on caribou has increased (McKay 1997, McNay *et al.* 2008).

In the case of declining populations of caribou in the Southern Mountain DU, Wilson (2009) recommended that wolf densities be managed to <1.5 wolves/1000 km^2, whereas Hebblewhite *et al.* (2007) suggested that caribou in Jasper National Park (Central Mountain DU) were most likely to persist when wolf densities were below 2.1-4.3 wolves/1000 km^2. In the Northern Mountain DU, recruitment of caribou increased 113% and adult mortality decreased 60% when wolf numbers were reduced 80% on the range of the Finlayson subpopulation in Yukon (Farnell and McDonald 1988). After the wolf removal program ended, the Finlayson population declined to pre-removal numbers (Adamczewski *et al.* 2007). Removal of 60-90% of wolves over three winters increased recruitment of the Horseranch caribou subpopulation to 16.7% from 5.5% (Bergerud and Elliott 1998). Caribou numbers increased during wolf removal and sterilization on the Aishihik caribou range (Hayes *et al.* 2003), and continued to increase after the program ended (Hegel and Russell 2010) where wolves may use bison as alternate prey (Jung 2011). In the Southern Mountain DU, on the Barkerville and Wells Gray (north) subpopulation ranges where wolves were removed and sterilized leading to densities of 3.2-3.4 wolves/1000 km^2 across about 60% of the study area, the Barkerville subpopulation increased and the Wells Gray (north) subpopulation remained stable, but calf recruitment was variable (Roorda and Wright 2012). Reduction of moose through liberalized hunting resulted in a 71% reduction in moose numbers and about a 50% reduction in wolf numbers on three ranges in the southern portion of the Southern Mountain DU; the Columbia North population experienced a modest increase while the two small populations (Columbia South, Frisby-Boulder) decreased (Serrouya 2013). In the northern portion of the Southern Mountain DU (Parsnip portion of the Hart Ranges), moose numbers declined, possibly as a result of increased hunting, but over 6 years, neither wolf nor caribou numbers appeared to respond (Steenweg 2011, D. Heard, pers. comm. 2013).

Industrial activities (IUCN Threats #3.1 [Oil and gas drilling], 3.2 [Mining and quarrying], 3.3 [Renewable energy], and 5.3 Logging and wood harvesting])

Habitat alteration on caribou ranges in the Northern Mountain, Central Mountain, and Southern Mountain DUs has been linked to increased overlap between caribou and other prey or predators that exist at higher numbers than would otherwise occur in ecosystems dominated by older-age forests (Peters 2010, Robinson *et al.* 2012). Loss and degradation of habitat is caused by the cumulative effects of natural and anthropogenic disturbance. Human activities contributing to habitat alteration include forest harvesting and salvage logging, oil and gas exploration and development, mineral and hydrocarbon exploration and development, flooding associated with hydroelectric dams, wind energy, agriculture, and settlement areas. Decreasing caribou populations are a result of development and human activities rather than natural causes.

Habitat alteration resulting from natural and industrial disturbance can affect caribou forage (Kranrod 1996, Sulyma 2001, Cichowski *et al.* 2008, Waterhouse *et al.* 2011), and the number and distribution of predators (Festa-Bianchet *et al.* 2011). The recovery of habitats to meet the needs of caribou can take decades, but is highly dependent on ecological conditions (e.g. cover type, soil conditions, disturbance characteristics, slope, aspect, elevation, climate change; Thomas and Armbruster 1996).

Forest succession after logging differs from that after natural disturbance; in particular, succession of lichens after logging depends on initial ecological conditions, degree of disturbance, surface treatment, and reforestation methods. On drier sites dominated by terrestrial lichens, the abundance of terrestrial lichen cover may decrease after clearcut harvesting (Miège *et al.* 2001), while on more moist sites, harvesting may promote an increase in terrestrial lichen cover (Sulyma 2001). Partial cutting can result in increased arboreal lichen abundance in the lower canopy of the residual forest until new regeneration begins to shelter the lower canopy of remaining trees, while heavier cuts can result in reduced arboreal lichen abundance (Stevenson and Coxson 2007).

Habitat alteration resulting in higher levels of early seral forest (and consequently apparent competition) has been associated with declines of caribou populations and lower adult survival (Smith 2004, Apps and McLellan 2006, Wittmer *et al.* 2007). In the Southern Mountain DU, Apps *et al.* (2013) suggested that habitat alteration functions at a broad scale and included winter ranges of primary prey beyond caribou ranges. In the Central Mountain DU, caribou avoid and are less abundant in areas disturbed by forest harvesting (Smith *et al.* 2000, DeCesare *et al.* 2012).

ATK holders also noted that forestry results in a high risk to caribou including loss of habitat and negative effects for population growth (Bilko 2006a, b, c, Littlefield *et al.* 2007). For example, starting in the 1950s clearcutting of large tracts of land started and by the 1970s it came into the Takla Lake area of central BC. The success of hunting animals and fish decreased and clear-cutting pushed all animals northwards (Stronen 2000, Littlefield *et al.* 2007).

Disturbance resulting from noise, traffic and/or other human-related factors can result in displacement of caribou from preferred or low predation risk habitats, increased stress, changes in movement patterns, increased energy expenditures and/or physical injury or death. Female caribou with calves are the most prone to disturbance, while bulls and all caribou during the insect harassment season are less likely to avoid disturbances (Wolfe *et al.* 2000). Physical disturbance from roads, drilling sites, and seismic lines have resulted in avoidance of habitats well beyond actual development footprints (Polfus *et al.* 2011, Williamson-Ehlers *et al.* 2013).

Industrial activities can lead to increased contamination of land and watersheds. First Nations communities in west-central Alberta observed changes in the colour of rivers and visible oil spills that they believe have resulted from increased industrial activities (West Central Alberta Caribou Landscape Planning Team 2008). Elders from the Kwadacha First Nation and Takla Lake First Nation expressed concern that caribou had been poisoned from drinking from the tailing ponds at Cheni Mines because they observed the stomach and intestines of hunted animals to be green and yellow (Littlefield *et al.* 2007). ATK from north-central BC also indicated that mining in the 1930s was a cause of local caribou population declines (McKay 1997, McNay *et al.* 2008).

Roads and Linear Features (IUCN Threat # 4.1 [Roads and railways] and 4.2 [Utility and service lines]

In general, caribou avoid disturbance that is associated with roads and other linear features (Oberg 2001, Hebblewhite *et al.* 2010a, Polfus *et al.* 2011, DeCesare *et al.* 2012, Williamson-Ehlers 2012), even when preferred habitat (e.g., winter habitat with abundant lichens) is available near those features (Florkiewicz *et al.* 2007). In the Southern Mountain DU, wolf predation on caribou occurred in association with roads at the fine scale, and roads may increase efficiency of movement of some predators and thereby increase encounter rates with caribou (Apps *et al.* 2013). Roads affect caribou survival directly through vehicle collisions and increased access for regulated and unregulated hunting (Brown and Hobson 1998, ASRD & ACA 2010). Improved access to the summer calving range may increase risk of disturbance by humans during this critical life stage; calving areas are the most sensitive of all habitats for caribou (Seip and Cichowski 1996). Other linear features of concern, which both bisect and fragment existing habitat and contribute to cumulative impacts, include oil and natural gas pipelines and hydro transmission corridors, of which there are multiple existing and planned projects in all three DUs (BC Hydro 2013, BC Environmental Assessment Office 2014, Energy BC 2014, Lamers 2014).

ATK notes that habitat fragmentation resulting from roads, railways, and industrial development has negative effects on caribou and habitat through elevated noise, dust, pollution, and contaminants; these effects can result in population decline or the abandonment of range ("chasing" them northwards). Starting with railroad construction in the early 1900s, caribou in the Telkwa Mountains of BC were impacted and by the 1960s they moved northwards in response to hunters associated with the railroad, mining exploration, and helicopter hunting (Stronen 2000). In the Amazay Lake area of BC, ATK holders noted that "Forestry and mining increased once transportation routes were established and extraction/harvest activities were described as having chased moose and caribou away because they dislike disturbance. The animals go away if there is machinery operating, because they don't like the noise. Newborn animals don't like the noise. The beaver and other animals get killed by the trucks" (William George [1997] in Littlefield *et al.* 2007).

Recreational Activities (IUCN Threat 6.1 [Recreational activities]

Recreational activities on caribou ranges in the Northern Mountain, Central Mountain, and Southern Mountain DUs include snowmobiling, backcountry skiing, heli-skiing, cat-assisted skiing, ATV use, and hiking. Snowmobiling can result in displacement (Powell 2004, Seip *et al.* 2007), increased stress (Freeman 2008), reduced feeding due to increased vigilance and movement (Powell 2004), and increased access for wolves along packed trails in winter (Powell 2004). Less information is available about the effects of heli-skiing, cat-assisted skiing, and summer recreational activities on caribou, but there is some evidence that heli-skiing results in displacement (Wilson and Hamilton 2003) and increased stress (Freeman 2008) in Southern Mountain DU caribou. Increased concentrations of the fecal stress hormones (glucocorticoids) were detected in caribou located up to 10 km away from winter recreational activities (Freeman 2008). Chronic disturbance and stress could potentially lead to reduced body condition and consequent population-level effects (Simpson and Terry 2000).

The disturbance effects of recreation appear to be common across the circumpolar distribution of *Rangifer*. Backcountry skiing/snowshoeing has resulted in displacement of reindeer in mountainous terrain in Norway (Reimers *et al.* 2003, 2006), increased vigilance following encounters for caribou in the Laurentian Highlands in Quebec (Duchesne *et al.* 2000), and increased access for wolves on packed trails. During summer, reindeer in mountainous areas in Norway avoided areas with tourist trails, resorts, and cabins (Vistnes and Nellemann 2001, Vistnes *et al.* 2008). Caribou reactions to recreational disturbance may also be influenced by environmental conditions. In Newfoundland, Mahoney *et al.* (2001) found that caribou in Newfoundland fled at shorter distances and responded more slowly to snowmobiles during a deep snow winter, presumably as an attempt to decrease energy expenditure. In Scandinavia, reindeer select insect relief areas distant from human activity, but will use insect relief areas where hiking activity is high, if those are the only insect relief areas available (Skarin *et al.* 2004, Vistnes *et al.* 2008)

Natural Disturbances (IUCN Threat #7.1 [Fire and fire suppression], 7.3 [Other ecosystem modifications], 10.3 [Avalanches and Landslides])

Similar to industrial development, habitat alteration following natural disturbance can affect caribou directly through the loss of forage, or through indirect impacts associated with habitat change favouring other prey species (Kranrod 1996, Sulyma 2001, Cichowski *et al.* 2008, Waterhouse *et al.* 2011). Fire and forest insects are the primary natural disturbances on low-elevation winter ranges of all western mountain caribou. Historically, when disturbance from a wildfire occurred in these ranges, caribou would shift their range to more suitable areas. However, the increase in industrial activities has reduced available suitable habitat such that natural disturbances are a more pronounced threat. As an example, the Mountain Pine Beetle has now killed a cumulative total of 710 million m^3 of timber. The cumulative area of B.C. affected to some degree (red-attack and grey-attack) is estimated at 18.1 million hectares (BC MFLRNO 2013). The Mountain Pine Beetle epidemic in BC and Alberta has initially resulted in increased abundance of dwarf shrubs, with a corresponding decrease in terrestrial lichens (Cichowski *et al.* 2008, 2009, Seip and Jones 2010, Waterhouse 2011) within Central and Northern Mountain caribou ranges.

Avalanches are a frequent occurrence in mountainous habitat and although not well documented, have been known to kill caribou. The last five individuals remaining in the Banff subpopulation were killed by an avalanche in 2009 (Hebblewhile *et al.* 2009). Seven of 31 (23%) of radio-collared caribou in the Lake Revelstoke study area were killed by avalanches between 1981-85 and 1992-98 (Flaa and Mclellan 2000). Wittmer *et al.* (2005) recorded 20 of 98 (20%) classifiable mortalities (total of 165 mortalities) as accidents, which included avalanches, birthing and falls. For comparison, predation was identified as a cause in 67 of 98 (68%) cases.

Parasites and Diseases (IUCN Threat # 8.1 [Invasive non-native alien species])

Although parasites and infectious diseases have not been found to be a significant direct cause of mortality in caribou in these three DUs, they may be under-diagnosed (H. Schwantje, pers. comm. 2013). Some have the potential to affect reproductive output and/or, as chronic diseases can lead to reduced vigour, the potential to result in greater susceptibility to predation. Climate change can lead to increased prevalence, intensity, and geographic distribution of some parasites, reduced parasite survival of others, facilitated invasion of new parasites, and the invasion of new hosts, resulting in introduction of new parasites and changes in abundance and distribution of endemic parasite species (Kutz *et al.* 2009).

Several macro and microparasites are known to have impacts on condition, survival, and fecundity of *Rangifer* at the individual and population levels. Prevalence of infection and outcomes are strongly influenced by community structure, behaviour, and habitat and climatic conditions. Although the literature on pathogens in western mountain caribou is limited, there are considerable data on infectious disease in caribou and reindeer elsewhere that demonstrate the potential impact of this threat. Ectoparasites of concern include ticks, lice, and insects. Tick paralysis caused by the Rocky Mountain wood tick (*Dermacentor andersoni*) has been reported in one of the caribou that was translocated to the Purcells in 2012. This caribou dispersed into the northern US and was found infested with wood ticks and paralyzed. Ticks were removed and the animal relocated to BC (L. de Groot, pers. comm. 2013). Several other of these animals were reported to have died from predation; however, the role of tick paralysis in increasing susceptibility to predation was not evaluated. Under conditions of increasing range restriction and climate warming, tick paralysis needs to be considered as a potentially important and irreversible limiting factor for caribou at the southern extent of their range. *Dermacentor albipictus,* the winter tick, also infests caribou and can cause severe clinical signs and debilitating disease (Welch *et al.* 1990).

Two tissue protozoan parasites of particular note are *Neospora caninum* and *Toxoplasma gondii*. Serological surveys for these parasites in these DUs have been limited; however, *Neospora caninum* was detected in 6% of caribou examined in BC (Sifton 2001), and in Chisana caribou in Yukon (Kutz *et al.* 2012). *Toxoplasma gondii* was found in Chisana caribou (Kutz *et al.* 2012) but not in any of the 111 caribou examined in BC (Sifton 2001). These parasites have a predator-prey lifecycle with a variety of cervids (including *Rangifer*) and bovids as intermediate hosts, where they can cause abortion, stillbirth, fetal abnormalities, and weak offspring (Kutz *et al.* 2012). The parasites may also be transmitted across generations transplacentally. Both parasites may have significant impacts on pregnancy rates and calf survival and are likely underdiagnosed.

In BC, the tissue protozoan *Besnoitia tarandi* was diagnosed in 23% of caribou sampled, with a higher proportion of animals infected in the northern part of the province (Lewis 1989). This intracellular parasite is common in barrenground caribou across northern Canada. It forms cysts within the skin and eye sclera and clinical signs of crusting and hair loss generally on the lower legs may occur, although in most cases infections are subclinical (Kutz *et al.* 2012). Although it is typically subclinical in wild barrenground caribou, severe outbreaks of disease have been reported in caribou in a zoo setting (Glover *et al.*, 1990) and in the George and Leaf caribou herds of Quebec (Ducrocq *et al.*, 2012). Epidemiological evidence in the latter also suggests lower winter survival of heavily infected animals (Ducrocq *et al.* 2013). *Besnoitia tarandi* has extremely limited genetic variability and may have previously been restricted to the Beringian lineage of caribou (Madubata *et al.* 2012). This may suggest that caribou of the North American lineage (i.e., Southern and some Central Mountain Caribou) are naïve and particularly susceptible to this parasite.

Gastrointestinal parasites are common among western mountain caribou (e.g., those found in Chisana caribou include Eimeria spp., cestodes, and nematodes *Nematodirus, Ostertagia gruehneri, Teladorsagia boreoarcticus*) (Hoar *et al.* 2009). *Ostertagia gruehneri* can cause gastrointestinal signs that influence body condition, fecundity, and population dynamics in Svalbard reindeer (Albon *et al.* 2002). The protostrongylid meningeal nematode, *Parelaphostrongylus tenuis* (meningeal worm or brainworm), causes severe and typically fatal neurologic disease in most North American cervids, with the exception of white-tailed deer (Kutz *et al.* 2012). It is considered a limiting factor for re-introduction of caribou in eastern Canada and US (Pitt and Jordan 1994). Until recently *P. tenuis* was restricted to eastern Canada and USA; however, a recent report of it in a moose in northwestern Saskatchewan (Canadian Cooperative Wildlife Health Centre) indicates a substantial westward range expansion and the potential to become an important limiting factor for western mountain caribou in the future.

Flying and biting insects can affect caribou by vectoring some blood-borne parasites and other pathogens. In some cases, insects can cause significant harassment and loss of blood. Important insects include warble flies (*Hypoderma tarandi*), nose bot flies (*Cephenemyaa trompe*), mosquitoes (*Aedes* spp.), black flies (*Simulium* spp.), horseflies (*Tabanus* spp.), and deer flies (*Chrysops* spp.). Summer behaviour of caribou is influenced by actions to reduce exposure to insects and insect-borne parasites. For example, the use of long-lasting snowbanks by caribou in summer is likely a response to insect harassment. The severity of insect harassment is related to insect density and weather, and observed climatic warming could add to the problem (see Witter *et al.* 2012).

Climate Change and Severe Weather (IUCN Threat # 11.1 [Habitat shifting and alteration] and 11.4 [Storms and flooding])

Caribou in the three DUs have adapted to a wide range of climate—from areas of high precipitation in mountains of the Southern Mountain DU to relatively dry conditions in the Central and Northern Mountain DUs. However, climate change will have a number of impacts on the distribution and abundance of caribou. Large-scale climate patterns can affect calf recruitment. In Yukon, the Pacific Decadal Oscillation (PDO) during the winter prior to birth and May climate at calving was positively related to calf recruitment (Hegel *et al.* 2010a). Higher PDO values during winter represent decreased precipitation and increased temperature during May, both leading to a reduced snowpack at calving and an earlier onset of the first snowfree day of the year. This can affect the ability of pregnant females to move to higher-elevation areas. The PDO had a slight negative affect on recruitment, possibly due to faster green-up and altered availability of highly nutritious forage needed for lactation and subsequent calf growth (Hegel *et al.* 2010b).

Detrimental effects of climate change could include altered frequency and severity of natural disturbances (fire and forest insects), changes in vegetation composition, shifts in species and distribution of other ungulates, and increased incidence of diseases and parasites (Vors and Boyce 2009). Increased summer temperatures and extended fire seasons could result in increased area disturbed by fire. Increased winter temperatures and fewer cold weather extremes could lead to increased forest insect activity. Currently, the Mountain Pine Beetle has affected significant portions of some Northern Mountain DU and Central Mountain DU caribou winter ranges in both BC and Alberta. In the past, caribou could respond to natural disturbance events, if needed, by shifting their distribution from disturbed areas to other portions of their range. However, as impacts from anthropogenic disturbance and climate change increase, caribou will have fewer suitable areas into which they can move either within or between ranges.

Climate change can result in changes to vegetation composition even without changes to natural disturbance patterns. Predicted warmer temperatures could lead to ecological conditions that favour vegetation species that can outcompete terrestrial lichens and/or that are preferred by other prey species (Hamann and Wang 2006). Vors and Boyce (2009) suggest that if green-up of vegetation shifts forward but timing of calving does not change, caribou may not be able to take advantage of high-quality forage when energy requirements are high during lactation. Even though caribou can dig through deep snow (>1 m; Johnson *et al.* 2000), this comes at a cost to energy reserves. A change in either snow depth or hardness may impede access to terrestrial lichens.

Changes in vegetation species and snow conditions due to climate change could result in northward expansion of ranges of other ungulate species and further alter predator-prey relationships. Hoefs (2001), for example, reports both mule (*Odocoileus hemionus*) and white-tailed deer have colonized the southern Yukon, with white-tailed deer first observed north of the BC border in 1975. Recently, there have been more observations of elk and white-tailed deer north of 62° along the Mackenzie Mountains in western NT (Veitch 2001, N. Larter, pers. comm. 2013).

Climate change could also result in more favourable conditions for diseases and parasites that affect caribou (see **Parasites and diseases**). Disease has played a major role in caribou declines in eastern North America where altered landscapes and mild winters allowed white-tailed deer carrying the meningeal worm to expand north and infect caribou (Bergerud and Mercer 1989). Longer summer seasons could also speed up life cycles for some parasites.

Overhunting (IUCN Threat #5.1 [Hunting and collecting terrestrial animals])

Historically, overhunting of caribou was a result of increased road access associated with industrial and recreational development (Bergerud 1978, Stevenson and Hatler 1985). Recreational (licensed) hunting is currently closed for all caribou in the Southern Mountain and Central Mountain DUs, and for most subpopulations in west-central and north-central BC. Where caribou hunting is open in BC, it is largely regulated through a 5-point bull-only season or limited entry hunting. Hunting by First Nations is unknown but suspected to be low for most subpopulations (Environment Canada 2014).

In Yukon, hunting for Northern Mountain DU caribou is closed or under permit for some subpopulations, and open for bulls only for most subpopulations. The average annual hunt by licensed hunters declined from over 300 in the 1980s to 212 in 2011. Hunting has been restricted to bulls since 1984 but First Nation harvest is unregulated and is suspected to equal that of licensed hunting (Farnell *et al.* 1998). In NT, hunting of Northern Mountain DU caribou is open for all subpopulations and either males or females can be hunted. Approximately 300-350 Northern Mountain DU caribou are hunted by First Nation or resident license holders each year (Environment Canada 2012).

Contaminants

Contaminants in caribou in Yukon were monitored from 1993 to 2004 (Gamberg 2004). Levels of cadmium were higher than for caribou in other areas, but cadmium in all caribou samples was less than the 400-800 ppm at which renal dysfunction can occur, and levels found in Yukon were considered background levels that enter the food chain from natural mineralization (Gamberg 2004). A recent study of caribou in the Mackenzie Mountains in NT (Larter *et al.* 2013) found that renal radionuclides were higher in caribou than the other 3 sympatric ungulates (mountain goat [*Oreamnos americanus*], Dall's sheep [*Ovis dalli dalli*], moose) but are not at levels of animal health/human consumption concern. Cadmium levels were lower than moose but higher than the other 2 ungulates, althugh there was mild evidence of cadmium toxicity in 5 of 6 caribou kidneys. Mercury was higher than for other ungulates and significantly higher than for moose.

Geography of Threats within Each DU2

Regional biologists (see **Authorities Contacted and Acknowledgements**) were queried on the most important threats in each DU, as summarized below.

Northern Mountain DU (7)

The diversity of threats and limiting factors affecting subpopulations in the Northern Mountain DU reflects the wide range of environmental conditions and levels of human activities across the DU (Environment Canada 2012). Major concerns across the DU include: altered predator-prey dynamics due to habitat change, human disturbance and habitat loss due to forest harvesting, mineral exploration and development, and associated access, changes in habitat structure following Mountain Pine Beetle infestations and/or associated salvage logging, and motorized and non-motorized recreational activities.

In the northern portion of this DU mineral exploration and development represent important threats identified for these subpopulations. These activities are expected to increase disturbance and access; the latter is expected to increase hunting pressure. Larger-scale habitat losses as a result of fire have also been identified as past and ongoing threats to caribou habitat. Although the density of roads in the northern part of the DU may be lower than in the southern part of the DU, vehicle collisions are a concern for the Carcross, Little Rancheria, Swan Lake, Tsenaglode, and Chase subpopulations where major highways or arterial roads traverse their ranges. In the southern part of the DU, altered predator/prey dynamics due to habitat change are primarily a result of forest harvesting, whereas in the northeastern part of BC, habitat change is largely a result of prescribed burning. Current and proposed mineral exploration and development has recently become more of a threat to subpopulations in Yukon. Multiple proposed mineral and hydrocarbon exploration and development projects and windfarms are becoming more of a threat in northcentral and northeastern

BC. Although proposed industrial activities have yet to take place, the effects of some of those activities could result in considerable impacts to caribou. Industrial activities have already resulted in concerns about reduced connectivity between subpopulations in that area. Some potential industrial projects in northwestern BC are likely to become more viable with the Northwest Transmission Line, which is currently being constructed.

Some threats do not affect a large number of subpopulations, but can be locally significant. For example, summer recreation (hiking and ATV use) in post-calving habitat is a major threat to the Telkwa caribou subpopulation in west-central BC. It also should be noted that many subpopulations are threatened by several threats simultaneously. For example, the Itcha-Ilgachuz subpopulation is threatened by habitat loss due to fire, Mountain Pine Beetle infestations, and timber harvesting in addition to increased access, hunting, and predation.

Central Mountain DU (8)

The primary threats to caribou in the Central Mountain DU include: altered predator-prey dynamics due to habitat change resulting from forest harvesting in combination with oil and gas exploration and development; and human disturbance and other habitat loss due to multiple industrial activities and associated infrastructure. Other factors include vehicle collisions, motorized recreation (ATV, snowmobiling), facilitated access for predators, small population effects, and the emerging threat of infectious disease, particularly in a changing climate. Cumulative effects from industrial activities are a concern in this DU because of the many industrial activities occurring. For example, threats on the Quintette subpopulation range include altered predator-prey dynamics due to habitat change resulting from forest harvesting in adjacent valley bottoms, coal exploration and development, gas exploration and development, and potential windfarms. The rate of development for most of those activities has increased considerably since the late 1990s (Williamson-Ehlers *et al.* 2013). Although existing windfarms are currently located outside high-value caribou habitats, investigative permits cover portions of three subpopulation ranges. In addition to direct disturbance from motorized recreation, snowmobiling can result in facilitated access for wolves into caribou ranges and continued ATV use will limit prospects for vegetation regeneration on linear features, a necessary component of habitat recovery.

Southern Mountain DU (9)

The primary threats to caribou in the Southern Mountain DU include altered predator/prey dynamics due to habitat change resulting from forest harvesting in adjacent low-elevation valley bottoms, and from increased predator efficiency using trails created by snowmobiling and other recreational activities. The emerging threat of infectious disease serves as an additional threat that will likely increase its impact, particularly in a changing climate. Altered predator-prey dynamics was a concern for all 14 subpopulations and heli-skiing and snowmobiling were concerns for 10 (67%) and 13 (87%) subpopulations, respectively. There were few concerns about industrial activities other than forest harvesting in valley bottoms, although the effects of the flooding of valley floors for hydroelectric generation was a concern for four subpopulations. Increasing isolation and the effects of small populations was indicated as a threat to three subpopulations (Narrow Lake, Groundhog, and Purcells Central). Small populations, in the short term, are at increased risk of extirpation as a result of ongoing impacts or catastrophic events and, in the long term, problems associated with low genetic diversity. Climate change trend towards drying and warming may threaten caribou in this DU through increased fire frequency and changes that favour competitor species (deer and moose).

Number of Locations

The concept of locations is not applicable to caribou subpopulations in each DU because of the variation in ecological conditions and threats, and the widespread and sometimes isolated distribution of caribou subpopulations within each DU.

PROTECTION, STATUS AND RANKS

Legal Protection and Status

Caribou in the former COSEWIC Southern Mountain population are currently listed as Threatened under the federal *Species at Risk Act*. This includes all caribou in the Southern Mountain and Central Mountain DUs and 9 subpopulations in the west-central BC and north-central BC portions of the Northern Mountain DU considered in this report. Caribou in the former Northern Mountains population, which includes most of the subpopulations in the Northern Mountain DU in this report, are currently listed as Special Concern under the federal *Species at Risk Act*. A Recovery Strategy under the federal *Species at Risk Act* for the Southern Mountain population was released in 2014 (Environment Canada 2014). A Management Plan was developed for caribou in the Northern Mountain National Ecological Area (Environment Canada 2012), which includes 36 of the 45 subpopulations of the Northern Mountain DU considered in this report.

Central Mountain DU caribou in Alberta are currently categorized as Threatened under Alberta's Wildlife Regulation of the *Wildlife Act*. All caribou in BC are identified as both species at risk and ungulates under the Government Actions Regulation of the *Forest and Range Practices Act*, and under the Environmental Protection and Management Regulation of the *Oil and Gas Activities Act*. Caribou are also a Schedule A species (designated as wildlife under the BC *Wildlife Act*), which offers protection from direct persecution and mortality (Province of British Columbia 1982). The Chisana caribou subpopulation in Yukon was designated as a specially protected wildlife population under the *Wildlife Act* in 2002, but may be removed pending a regulation review. In 1984, caribou in the Selkirk Mountains of Idaho and Washington were listed as Endangered by the US Fish and Wildlife Service under the US *Endangered Species Act*. Caribou are not listed by the Convention on International Trade in Endangered Species (CITES).

A provincial recovery strategy was prepared for the deep snow mountain ecotype of caribou of the Southern Mountain population in BC (MCTAC 2002) and, subsequently, the Mountain Caribou Recovery Implementation Plan was announced in 2007 (Mountain Caribou Recovery Implementation Plan Progress Board 2012). A draft recovery strategy was developed for shallow-snow ecotype of caribou of the Southern Mountain population (i.e. Southern Mountain National Ecological Area) in BC, but was not endorsed by the BC government (NCTAC 2004). A Recovery Implementation Plan was also developed for the shallow-snow ecotype of caribou of the Southern Mountain population in north-central BC, but was not endorsed by government (McNay *et al.* 2008). More recently, an Implementation Plan was developed for the South Peace subpopulations in BC including the Quintette, Burnt Pine, Kennedy Siding, Moberly, and Scott subpopulations in the Central Mountain DU, and the Graham subpopulation in the Northern Mountain DU (BC Ministry of Environment 2013).

In Alberta, a recovery plan for caribou received qualified approval by government in 2005 (Alberta Woodland Caribou Recovery Team 2005, ASRD&ACA 2010). As part of that plan, the West Central Alberta Caribou Landscape Planning Team was formed and the team developed a landscape plan for the area (West Central Caribou Landscape Planning Team 2008). That landscape plan was not officially approved or endorsed by the Alberta government.

Federal, provincial/territorial, and/or First Nation governments have developed management plans or recommendations for individual subpopulations (e.g., Chisana Caribou Herd Working Group 2012). The Southern Lakes Caribou Recovery Program called for the cessation of all hunting on the Ibex, Carcross and Atlin herds after 1993 (Southern Lakes Caribou Recovery Program Progress Report, 1992 – 1996.), when six Yukon First Nations (Carcross, Tagish, Kwanlin Dun, Teslin Tlingit, Ta'an Kwach'an, Champagne and Aishihik) and the Taku River Tlingit in BC voluntarily stopped hunting those herds. The Taku River Tlingit resumed hunting the Atlin herd in 2007. BC has maintained a 5-point bull caribou season on the Carcross herd over the moratorium period. The Tlingit have had a voluntary closure on caribou hunting of the Carcross subpopulation since the early 2000s (Botkin *et al.* 2005, Clark 2006), and the West Moberly First Nation has had a voluntary closure on caribou hunting in the Moberly area since the flooding of the Williston Reservoir in the 1970s (West Moberly First Nations v. British Columbia, 2011).

All jurisdictions have legislation that is used to close hunting, establish limited entry hunts of specific sex and age classes, prohibit night hunting, etc. (see **Threats and Limiting Factors – Hunting**).

Non-Legal Status and Ranks

Globally, caribou are listed by the International Union for Conservation of Nature (IUCN) as Least Concern, but subspecies or ecotypes are not differentiated (IUCN 2012). NatureServe ranks caribou as secure globally, secure at the population level (T) for the Northern Mountain DU, and imperilled at the population level for caribou in the Southern Mountain and Central Mountain DUs considered in this report (NatureServe 2012). Provincially, caribou in the Southern Mountain DU and in the Alberta portion of the Central Mountain DU are ranked as Critically Imperilled, caribou in the Central Mountain and Northern Mountain DUs in BC and in the Northern Mountain DU in Yukon are provincially ranked as vulnerable, while caribou in the Northern Mountain DU in the NT are ranked as secure. In BC, all Northern Mountain DU and Central Mountain DU caribou are on the Blue list, and all Southern Mountain DU caribou are on the Red list. In the US, caribou in Idaho and Washington are ranked critically imperilled (S1), while caribou in Alaska are ranked secure (S5; NatureServe 2012). Alaska has identified the Chisana subpopulation of caribou as a species of conservation concern (ADFG 2006).

Habitat Protection and Ownership

The majority of caribou habitat in the Northern Mountain, Central Mountain, and Southern Mountain DUs is on public land. In NT, much of the Redstone subpopulation range is included the southwestern portion of the Sahtu Settlement Area, and in the southern portion of the Gwich'in Settlement Area within a restricted development area.

Protected areas cover 22%, 41%, and 32% of the Northern Mountain, Central Mountain, and Southern Mountain DUs respectively. Provincial or territorial protected areas make up 84%, 70%, and 40% of the area protected within Northern Mountain, Central Mountain, and Southern Mountain DU caribou range areas, respectively. In the Northern Mountain DU, Nahanni National Park Reserve and the adjacent Naats'ich'oh National Park Reserve cover over 2.5 million ha of contiguous caribou range, and Spatsizi Wilderness Park, Northern Rocky Mountains Park, and Tweedsmuir Park each protect over 600 000 ha of caribou range. In Yukon, Tombstone Territorial Park protects over 220 000 ha of caribou habitat. Most of the rest of the areas protected within caribou ranges in the Northern Mountain DU are less than 100 000 ha in size.

In the Central Mountain DU, about 80% of the protected landbase within caribou ranges is included in Jasper National Park, Willmore Wilderness Park, Kakwa Wildland Park (Alberta), and Kakwa Park (BC). The contiguous area of protection contains mostly high-elevation summer range for the Narraway, A La Peche, and Redrock-Prairie Creek subpopulations and all of the Tonquin, Brazeau, and Maligne (Jasper) subpopulation ranges. Most low-elevation winter ranges and most areas within the other subpopulation ranges in the Central Mountain DU (i.e., in the northern half of the DU) are not protected.

In the Southern Mountain DU, about 70% of the protected landbase within caribou ranges is included in 3 contiguous provincial parks: Wells Gray, Cariboo Mountains, and Bowron Lake parks, which protect portions of the Wells Gray and North Cariboo Mountains subpopulation ranges. The remaining protected areas (or portions of protected areas) that are located within caribou ranges are each less than 35 000 ha in size.

As of 2009, 2.2 million hectares of caribou habitat in the Southern Mountain DU have been either designated as Ungulate Winter Ranges or Wildlife Habitat Areas under the Government Actions Regulation of the *Forest and Range Practices Act* or protected in existing protected areas, and approximately 1 000 000 ha were closed to motorized vehicles (primarily to restrict snowmobiling) under the Motor Vehicle Prohibition Regulation of the *Wildlife Act* (BC Ministry of Environment 2009). Ungulate Winter Ranges and Wildlife Habitat Areas include primarily high-elevation range and General Wildlife Measures for those designations generally provide for areas of no forest harvesting and modified forest harvesting. They also provide restrictions on mineral exploration and guided adventure tourism activities during the calving season. Ungulate Winter Ranges and Wildlife Habitat Areas have also been designated in the Central Mountain and Northern Mountain DUs in BC. General Wildlife Measures for those areas vary with respect to the proportion of area excluded from forest harvesting, and the levels and methods of forest harvesting in modified harvest areas.

The South Peace Northern Caribou Implementation Plan (BC Ministry of Environment 2013) provides for protection of ≥90% of identified high-elevation winter ranges across the plan area (includes Graham subpopulation from Northern Mountain DU, and Moberly, Scott, Burnt Pine, Quintette, and Narraway subpopulations from Central Mountain DU), and for protection of ≥80% of identified high-elevation winter ranges specifically on the Quintette range, but does not specify how the protected portion of the range will be distributed geographically. The BC government has also used Section 16 *Land Act* reserves, Resource Review Areas under Oil and Gas Policy, Ungulate Winter Ranges and Wildlife Habitat Areas under the *Oil and Gas Activities Act*, No Disposition Reserves under the *Mineral Tenure Act* and *Coal Act*, to legally protect caribou habitat.

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Deborah Cichowski is an independent consultant based in Smithers, British Columbia. She received her BSc and MSc degrees from the University of British Columbia and has been involved with research, inventory, planning and management of caribou in British Columbia since 1985. Her current research recent work has focused on the effects of the mountain pine beetle epidemic on caribou habitat use and terrestrial lichens. Deborah has been involved with recovery planning for northern and boreal caribou in British Columbia and has prepared a number of documents that summarize the current state of knowledge and issues facing caribou populations.

COLLECTIONS EXAMINED

None.

Appendix 1. Reported survival rate data for subpopulations of caribou within the the Northern Mountain DU (DU7), Central Mountain DU (DU8) and Southern Mountain DU (DU9) for calculation of generation length.

Southern Mountain DU		Central Mountain DU		Northern Mountain DU	
Subpopulation	**Mean annual adult female survival rate ±SE[1]**	**Subpopulation**	**Mean annual adult female survival rate[2]**	**Subpopulation**	**Mean annual adult female survival rate**
South Purcells	0.55 ± 0.10	Moberly	0.739	Telkwa[3]	0.883 (adult) 1998-2008
Nakusp	0.85 ± 0.04	Burnt Pine	0.857	Chisana[4]	0.77 ± 0.06 (adult) 1989-1997
Columbia South	0.85 ± 0.04	Kennedy Siding	0.848	Wolf Lake[4]	0.89 ± 0.04 (adult) 1993-1997
Columbia North	0.81 ± 0.03	Quintette	0.915	Aishihik[4]	0.87 (adult) 1991-1992
Frisby-Boulder	0.90 ± 0.10	Narraway (Bearhole/Redwillow)	0.806	Swan Lake[3]	0.90 ± 0.06 2005-2007
Groundhog	0.78 ± 0.10	Narraway (Narraway)	0.828	Little Rancheria[3]	0.89 ± 0.05 1996-2000
Wells Gray	0.84 ± 0.10	A La Peche	0.905	Horseranch[3]	0.88 ± 0.05 1997-2000
Barkerville	0.88 ± 0.10	Redrock-Prairie Creek	0.859	Tweedsmuir-Entiako[5]	0.83 (1984-2003 except 1988/89, 1989/90, 1991/92)
North Cariboo Mountains	0.91 ± 0.10	Jasper	0.880	Muskwa[6]	0.85 (2000-2003)
Hart Ranges	0.96 ± 0.10				
Mean	0.83	Mean	0.849	Mean	0.863

[1] From Wittmer *et al.* (2005)

[2] Moberly, Burnt Pine, Kennedy Siding, Quintette and Narraway (Bearhole/Redwillow) from Seip and Jones (2013); Narraway (Narraway), A La Peche, Redrock-Prairie Creek and Jasper from ASRD&ACA (2010)

[3] From BC Ministry of Forests, Lands, and Natural Resource Operations unpublished data

[4] From Hayes *et al.* 2003 (only pre-wolf removal or control subpopulation data is used here)

[5] From Cichowski and MacLean 2005

[6] From Tripp *et al.* 2006

IUCN generation length calculation: Generation length = (1/mortality rate) + age at first reproduction
Southern Mountain DU: (1/0.17) + 2 = 5.88 + 2 = 8 years
Central Mountain DU: (1/0.15) + 2 = 6.67 + 2 = 9 years
Northern Mountain DU: (1/0.137) + 2 = 7.28 + 2 = 9 years

Appendix 2. Estimates of total numbers and number of mature individuals for subpopulations in Northern Mountain DU (DU7) based on surveys conducted within the last 3 generations (27 years).

Subpopulation	Previous survey estimates within 3 generations (27 years)[1]						Most recent survey/estimate[1]									
									Survey estimate				Population estimate			
	Year	Type	%CI	Total	CI	Mature[2]	Year	% CI	Type[3]	Total	CI	Mature[2]	Total	CI	Mature[2]
Northern Yukon/Northwest Territories															
Hart River	*1978	MC+Ex		1200[4]		914[5]	2006	90	MR	2200	1655-2745	1853	2200	1655-2745	1853
Clear Creek							2001		SRQ+Ex	900		801	900		801
Bonnel Plume							1982		EO			4200[6]	5000[7]		4200[6]
Redstone							2012		GS	>10000		>7300[6]	>10000		>7300[6]
South Nahanni	2001	MR	95	1432[8]	970-2933	1337	2009	95	MR	2105	1591-3029	1886[9]	2105	1591-3029	1886[9]
Coal River	*1997	MC+Ex		450[10]		392	2008		MC+Ex			413[11]	450[11]		413[11]
La Biche							1993		MC+Ex			388[12]	450[12]		388[12]
Southwest Yukon															
Chisana[13]	2003 2005 2007	MR MR MR		720 706 766		607 603 704	2010	90	MR	682	622-832	587	682	622-832	587
Kluane	*1997 2003[14]	MR MC		191 235		144 204	2009	95	MR	181	165-197	163	181	165-197	163
Aishihik	1981 1991 1993[15] 1997	MC MC MC SRQ	 90	1500 785 732 1148	 1073-1223	1399[16] 732 515[17] 889	2009	95	MR	2044	1724-2507	1813	2044	1724-2507	1813
Klaza	*1989 *2000	MR MC+Ex		485[18] 700[19]		383[20] 609[19]	2012		MR	1180	952-1461	1065	1180	952-1461	1065
Central Yukon															
Ethel Lake							1993		SRQ	316[21]		289[21]	316[21]		289[21]
Moose Lake							1991[22]		MC+Ex	300		270	300		270
Tay River							1991	90	SRQ	3758	3187-4329	2907	3758	3187-4329	2907
Tatchun							2000		MR	521		415	521		415
Pelly Herds							2002		MC+Ex	1000[23]		876	1000[23]		876
Finlayson	1986 1990 1996 1999	SRQ SRQ SRQ SRQ	90 90 90 90	3067 5950 4537 4130	2653-3481 4897-7003 3997-5077 3432-4828	2350 4474 3661 3383	2007	90	SRQ	3077	2905-3249	2657	3077	2905-3249	2657
Southern Lakes Yukon															
Wolf Lake	1987 1993	SRQ SRQ	90 90	664[24] 1249	531-797 1099-1399	551 1130	1998	90	SRQ	1491	1044-1938	1240	1491	1044-1938	1240
Laberge							2003	90	SRQ	200	100-300	176	200	100-300	176
Ibex	1998 2002	SRQ MC	90	424 400	326-522	329 375	2008	90	SRQ	850	790-910	748	850	790-910	748
Carcross[25]	1997 2003	SRQ DS	90 90	403 750	278-527 465-1200	312 675	2007	90	DS	775	642-935	674	775	642-935	674
Atlin[25]	1999	SRQ	90	809	666-951	679	2007	90	SRQ	777	641-913	666	600-1000		514-857
Northwest BC															
Swan Lake[25]							2007		MC+EX	600-800[26]		515-686	600-800[26]		515-686
Little Rancheria[25,27]	*1988	SRQ	90	681[28]	545-817	560	1999		SRQ+Ex[28,30]				800-1600		672-1342[29]
Horseranch[25]							2000		MC+Ex	80[illegible] 1000		680-850	800-1000[31]		680-850
Level Kawdy							1998		MC+Ex	1538[32]		1239	1538[32]		1239
Edziza							2006		MC	151		140	151		140
Tsenaglode							2008		EO				100-400		85-340[33]
Spatsizi							1994		MC+Ex	2681[34]		2258[34]	2681[34]		2258[34]
Northeast BC															
Liard Plateau[25]	2005 2010	MC MC		141 173		122 161	2011		MC	151		140	151		140

Subpopulation	Previous survey estimates within 3 generations (27 years)[1]						Most recent survey/estimate[1]								
							Year	% CI	Survey estimate				Population estimate		
	Year	Type	%CI	Total	CI	Mature[2]			Type[3]	Total	CI	Mature[2]	Total	CI	Mature[2]
Rabbit	*1996 *2000	MC MC		354 636		287 564	2007		MC+Ex	1133[35]		954	1300		1095
Muskwa	2001	MC		658		602	2007		MC+Ex	738[36]		611	1000[36]		828
Galaga							2000[37]		MC	265		220	265		220
Frog							2001[38]		MC	237		199	237		199
Finlay	1994	MC		193		170	2002		SRQ	26		19	26		19
Pink Mountain							1993[39]		MC	1275		1145	1275		1145
Northcentral BC															
Graham	1989 2002	MC MR	 95	587 282	 177-609	490 255	2009[40]	95	MR	708	311-1558	637	708	311-1558	637
Chase	*1993 *2002 *2007 *2008	MC MR MC+SCF MC+SCF		397 370 561 628		299 301 479 513	2009[41]		MC + SCF	475		404	475		404
Wolverine	1996 2002 2004 2007 2008 2009	MR MR SRB MC+SCF MC+SCF MC+SCF		361 471 369 375 349 378		324 352 299 314 297 335	2010		MC + SCF	341		298	341		298
Takla	1998	MC		102		82[42]	2004		MR	122		98	122		98
West-central BC															
Telkwa[43]	1982 1983 1984 1985 1987 1994 1996 2002 2004 2006 2008 2009 2011	MC MC MC MC MC MC MC MC MC MC MC MC MC+Ex		71 68 67 48 40 15 15 58[44] 86 90 71 44 26[47]		62[45] 59 49 37[46] 33 12 8 40 62 66 64 39 40[47]	2013		MC+Ex	16		12	25[48]		19[48]
Tweedsmuir	1987	MR	90	471	316-872	433	2002		MC+Ex	300[49]		248[49]	300[49]		248[49]
Itcha-Ilgachuz[50]	*1982 1985 1987 1989 1991 1994 1996 1998 2000 2002 2003 2007	MC MC MC MC MC MC MC MC MC MC MC MC		711 985 933 1175 1408 1136 1327 2121 2165 2862 2861 1784		514 730 675 848 1110 843 993 1564 1494 2119 2161 1547	2012		MR	1685	1431-1791	1220 (990-1550)	1685[51]	1431-1791	1220[51] (990-1550)
Rainbows	1986 1987 1995 1996 1997 1998 1999 2000	MC MC MC MC MC MC MC MC		117 103 178 127 106 107 120 108		95 92 162 118 103 94 100 86	2008		MC	50[52]		43[52]	50[52]		43[52]
Charlotte Alplands[53]	1993 1994 1998 1999 2000 2001	MC MC MC MC MC MC		53 42 28 39 12 23		38 35 25 36 12 19	2012[54]		MC	7[54]		6[54]	7[54]		6[54]

[1] Where survey estimates were not provided in the survey report, the total number counted (minimum count) was used as the survey estimate and population estimate. Source documents for surveys in this table are listed in Apppendix 2A. Surveys indicated with an asterix [*] were not considered comparable to the most recent estimate because of an unknown or smaller survey area.

[2] The number of mature individuals was derived by applying the proportion of adults in the survey to the survey estimate or population estimate

[3] DS = distance sampling; EO = expert opinion; GS = ground survey; MC = minimum count; MC+Ex = minimum count + extrapolation; MC+SCF = minimum count + sightability correction factor; MR = mark/resight; SRQ = stratified random quadrat

[4] Based on 977 caribou counted during a sheep survey in 1978 (Farnell and Russell 1984). This estimate is provided for an historical perspective but no details were provided so a long-term trend was not estimated

[5] The number of mature individuals was derived by applying the average % adults from the April 1981 and 1982 composition surveys from the nearby Bonnet Plume subpopulation (from Farnell and Russell 1984)

[6] The number of mature individuals was derived by applying the average % adults from hunter observations from 1991 to 2010 (Larter 2012)

[7] Based on 1074 caribou counted during a survey in April 1982 and extent of snow tracking sign (Farnell and Russell 1984)

[8] Population estimate based on re-analysis of data from Gunn *et al.* 2002 (T. Hegel, pers. comm. 2013)

[9] The 2001 and 2009 surveys areas were different so the survey estimates are not directly comparable. The number of mature individuals estimated in 2009 for the same survey area as the 2001 survey was 1465.

[10] Estimate based on 383 caribou counted in October 1997. No trend estimated between 1997 and 2008

[11] Estimate based on 341 caribou counted in October 2008

[12] Estimate based on 348 caribou counted in October 1993

[13] Fall composition surveys have been conducted annually from 1987 to 2011 except 1989 and 2004 (Chisana Working Group 2012). Data prior to 2003 is not included because population estimates were based on an interpolation of composition data. Since 2003, population estimates are based on formal estimates of the subpopulation's size and are not directly comparable to pre-2003 estimates.

[14] The 2003 survey was a fall composition survey so it was not a formal population estimate. However, a large number of animals were seen.

[15] The 1993 estimate was derived by Hayes *et al.* (2003) using the March 1994 survey data, subtracting the number of calves and adjusting for an assumed adult mortality rate of 10%

[16] The number of mature individuals was derived by applying the proportion of adults during the 1991 survey to the 1981 estimate

[17] The number of mature individuals was derived by applying calf:cow and bull:cow ratios from the previous October survey to the estimate (from Hayes *et al.* 2003)

[18] Includes corrected number of males based on October 1988 bull:cow ratios (Farnell *et al.* 1991). Total counted = 378 x SCF of 1.166 (12 of 14 collars seen) = 441 + 44 (# of bull assumed missed in March 1989 survey). Survey did not include all of current known range.

[19] Based on 671 caribou counted in October 2000. Survey did not include all of current known range.

[20] The number of mature individuals was derived using the proportion of adults in the classified sample (286/371) x total counted (378) = 291 x 1.166 (SCF) = 339 + 44 (bulls missed) = 383

[21] All caribou were seen during the survey so the SCF was 1.0 (Kuzyk and Farnell 1997)

[22] 211 counted during a rut count so estimate that the herd could number up to 300 caribou (Kuzyk and Farnell 1997)

[23] Based on 744 caribou counted during a survey in October 2002

[24] 528 caribou were counted. The expanded estimate (correcting for secondary survey blocks not surveyed) was 578 then an SCF of 1.15 was applied = 664

[25] The ranges of the Carcross, Atlin, Swan Lake, Little Rancheria, Horseranch and Liard Plateau subpopulations straddle the Yukon/BC border

[26] Based on 442 caribou counted during a fall composition survey in October 2007

[27] It is unclear whether the difference between the Little Rancheria 1999 estimate and the 1988 estimate was due to a change in numbers, differing survey areas or differences in caribou distribution (and subpopulations using the survey area) so long-term trend was not calculated

[28] 339 caribou were counted. The expanded population estimate (correcting for secondary sample units not sampled) was 502 then applied SCF of 1.357 = 681

[29] An SRB was conducted on the winter range in March 1999. The total estimate was 1817-1836 with +/-13% (90% CI). Radio-collared caribou from both the Horseranch and Little Rancheria subpopulations were present in the survey area so the estimates for each subpopulation were based on the radio-collared sample.

[30] Since 1999, the highest count was 842 caribou counted in October 2004

[31] Based on 806 caribou counted during a survey in October 2000. In February 2009, 505 caribou were counted on a portion of the range.

[32] Based on 1398 caribou counted during a survey in October 1998. The estimate is based on assuming that 90% of the caribou were seen (Marshall 1999). Since 1998, the highest number counted was 898 caribou during a fall composition survey in 2011 (Jex 2011), but was not intended as a population survey.

[33] The number of mature individuals was derived by assuming 85% adults

[34] Based on 2145 caribou counted in March 1994. The estimate was calculated assuming that 80% of the caribou were seen.

[35] Based on 1133 caribou counted in the Rabbit range during a sheep survey in 2007 (BC MFLNRO, unpublished data)

[36] 738 caribou were counted in the Muskwa range during a sheep survey in 2007 (BC MFLNRO, unpublished data). The population estimate is a subjective estimate based on the number counted during the 2007 survey.

[37] There is insufficient information available to determine whether this was a full count or a partial count so this estimate should be considered a minimum number present until a full survey can be conducted, and should not be used to assess trend when a full survey is conducted. Since 2000, 101 caribou and 138 caribou were counted on portions of the Gataga range in 2001 and 2007 respectively

[38] There is insufficient information available to determine whether this was a full count or a partial count so this estimate should be considered a minimum number present until a full survey can be conducted, and should not be used to assess trend when a full survey is conducted.

[39] Since 1993, 264 were counted in 1994, 333 were counted in 1995, 377 were counted in 2000, and 266 caribou were since counted in the Pink Mountain Range during a sheep survey in 2007 (BC MFLRNO, unpublished data)

[40] The 2009 Graham survey included 2 survey blocks not included in the 2002 survey. If those two blocks are excluded, the 2009 estimate would be 301 (95% CI=132-662). The 1989 survey included 1 survey block not included in the 2002 survey.

[41] A survey was conducted in 2010 with an estimate of 347 but the 2009 survey is used as the estimate

[42] The number of mature individuals was derived by applying the proportion of adults in the 2004 survey to the total counted in 1998

[43] A number of aerial surveys have been conducted in the Telkwa Mountains since the mid-1960s. A total of 180, 271, 166 and 40 caribou were counted during fixed-wing aerial surveys in 1964, 1965, 1966 and 1967. No surveys were conducted from 1969 to 1974. Between 1975 and 1981, the highest number counted during a given year ranged primarily between 30 and 40. This table lists a selection of surveys to show the general pattern of change between 1982 and 2012.

[44] The Telkwa subpopulation was augmented with 12 caribou in 1997 and 20 caribou in 1999

[45] The number of mature individuals was derived by applying the proportion of adults in the 1983 survey to the total counted in 1982 (no composition data available)

[46] The number of mature individuals was derived by applying the proportion of adults in the 1984 survey to the total counted in 1985 (no composition data available)

[47] The population estimate is a subjective estimate based on the number counted in 2011

[48] The population estimate is a subjective estimate based on the number counted in December 2013

[49] The population estimate is a subjective estimate based on the 178 caribou counted in March 2002; the highest number of caribou counted since 2002 was 166 caribou in October 2008 (Cichowski 2010)

[50] Post-calving aerial surveys were conducted annually from 1982 to 2003 (except 1993) for the Itcha-Ilgachuz subpopulation and sporadically since then. Although population size was estimated most of those years, numerical values of those population estimates were not available at the time this draft was completed so the number of caribou counted is reported here. The number of caribou counted during post-calving surveys does not necessarily represent the whole population since bulls are often underrepresented; therefore the number of mature individuals may be higher than reported here. This table lists a selection of surveys to show the general pattern of change between 1982 and 2012.

[51] Population estimate based on mark-resight

[52] Total estimate of 50 based on a total of 44 caribou seen (38 adults, 6 calves). The estimated number of mature individuals was calculated by applying the proportion of adults in the survey to the total estimate of 50.

[53] A total of 52 caribou were transplanted into vacant habitat in the Charlotte Alplands between 1984 and 1991 (Young *et al.* 2001).

[54] A total of 7 caribou were seen during a goat survey that also included all high-elevation caribou habitat in the area (N. Freeman, pers. comm. 2012).

Appendix 2a. Source documents for survey data in Appendix 2.

Subpopulation	Previous surveys (reference)	Most recent survey year (reference)
Hart River	Farnell and Russell 1984	Hegel *et al.* 2013
Clear Creek	N/A	Hegel *et al.* 2013
Bonnet Plume	N/A	Farnell and Russell 1984 Larter 2012
Redstone	N/A	NT ENR, unpublished data Larter 2012
South Nahanni	Environment Yukon, unpublished data	Hegel *et al.* 2013
Coal River	N/A	Hegel *et al.* 2013
Labiche	N/A	Hegel *et al.* 2013
Chisana	Environment Yukon, unpublished data	Hegel *et al.* 2013
Kluane	Environment Yukon, unpublished data	Hegel and Russell 2010
Aishihik	Hayes *et al.* 2003 (1997 – mature individuals) Environment Yukon, unpublished data	Hegel and Russell 2010
Klaza	(1989) Farnell *et al.* 1991 (2000) Environment Yukon, unpublished data	Hegel *et al.* 2013
Ethel Lake	N/A	Kuzyk and Farnell 1997
Moose Lake	N/A	Kuzyk and Farnell 1997
Tay River	N/A	Kuzyk and Farnell 1997
Tatchun	N/A	Hegel *et al.* 2013
Pelly Herds	N/A	Hegel *et al.* 2013
Finlayson	(All – totals) Adamczewski *et al.* 2007 (All – mature individuals) Environment Yukon, unpublished data	Adamczewski *et al.* 2007
Wolf Lake	(1987) Farnell and McDonald 1989 (1993 – total) Hayes *et al.* 2003 (1993 – mature individuals) Environment Yukon, unpublished data	(1998 – total) Hayes *et al.* 2003 (1998 mature individuals) Hegel *et al.* 2013
Laberge	N/A	(2003 – total) Florkiewicz 2008 (2003 – mature individuals) Hegel *et al.* 2013
Ibex	Environment Yukon, unpublished data	Hegel *et al.* 2013
Carcross	Environment Yukon, unpublished data	(2007 – total) Florkiewicz 2008 (2007 – mature individuals) Hegel *et al.* 2013
Atlin	Marshall 1999a	Marshall 2007
Swan Lake	N/A	BC MFLNRO, unpublished data
Little Rancheria	Farnell and McDonald 1990	Marshall 1999b
Horseranch	N/A	BC MFLNRO, unpublished data
Level Kawdy	N/A	Marshall 1999c
Edziza	N/A	BC MFLNRO, unpublished data
Tsenaglode	N/A	M. Williams, pers. comm. 2013
Spatsizi	N/A	Cichowski 1994
Liard Plateau	Powell 2006	McNay and Giguere 2013
Rabbit	BC MFLNRO unpublished data	BC MFLNRO, unpublished data
Muskwa	Tripp *et al.* 2006	BC MFLNRO, unpublished data
Gataga	BC MFLNRO unpublished data	BC MFLNRO, unpublished data
Frog		BC MFLNRO unpublished data
Finlay	Wood 1994	Zimmerman *et al.* 2002
Pink Mountain	BC MFLNRO unpublished data	BC MFLNRO unpublished data
Graham	(1989) Backmeyer 1990 (2002) Culling *et al.* 2005	Culling and Culling 2009
Chase	(1993) Corbould 1993 (2002) Zimmerman *et al.* 2002	McNay *et al.* 2009

Subpopulation	Previous surveys (reference)	Most recent survey year (reference)
	(2007) Giguere and McNay 2007 (2008) Giguere and McNay 2008	
Wolverine	(1996) Wood 1998 (2002) Zimmerman *et al.* 2002 (2004) Wilson *et al.* 2004a (2007) Giguere and McNay 2007 (2008) Giguere and McNay 2008 (2009) McNay *et al.* 2009	McNay *et al.* 2010
Takla	Poole *et al.* 2000	Wilson *et al.* 2004b
Telkwa	BC MFLNRO, unpublished data	BC MFLNRO, unpublished data
Tweedsmuir	Cichowski and MacLean 2005	BC MFLNRO, unpublished data
Itcha-Ilgachuz	(1982-2000) Young and Freeman 2001 (2002-2007) Roorda and Dielman 2007	Wilson 2012
Rainbows	(1986-2000) Young and Freeman 2001	Freeman 2009
Charlotte Alplands	Young *et al.* 2001	BC MFLNRO, unpublished data

Appendix 3. Estimates of total numbers and number of mature individuals for subpopulations in Central Mountain DU (DU8) based on surveys conducted 3 generations ago and 2 generations ago, and on the most recent survey.

	Earliest, highest previous survey estimate within 3 generations (27 years)[1,2]			Earliest, highest previous survey estimate within 2 generations (18 years)[1,3]			Most recent survey/estimate[1]				
							Year	Survey estimate		Population estimate	
Subpopulation	Year	Total	Mature[4]	Year	Total	Mature[4]		Total	Mature[4]	Total	Mature[4]
Scott											
Scott East	*2007*	*23*	*18*	*2007*	*23*	*18*	*2014*	*18*	*16*	*18*	*16*
Scott West	*2007*	*25*[5]	*19*[5]	*2007*	*25*[5]	*19*[5]	*2007*	*25*[5]	*19*[5]	*25*[5]	*19*[5]
Moberly	1995	*189	*163	1996	*181	*164	2014	22	18	22	18
Kennedy Siding	2007	*120	*103	2007	*120	*103	2014[6]	30	29	30	29
Burnt Pine	1996	*20	*18[7]	1996	*20	*18[7]	2013[8]	0	0	0	0
Quintette	2008	173 (173-218)[9]	147	2008	173 (173-218)[9]	147	2014[10]	106 (98-113)	87	106 (98-113)	87
Narraway											
Bearhole/Red-willow	*2008*	**49*	**46*	*2008*	**49*	**46*	*2014*	**14*	**13*	**14*	**13*
Narraway – other[11]	*2008*	*(131)*	*(118)*	*2008*	*(131)*	*(118)*	*2012*	*(72)*	*(65)*	*(72)*	*(65)*
Redrock-Prairie Creek[12]	1999	(478)	(401)	1999	(478)	(401)	2012	(127)	(106)	(127)	(106)
A La Peche[13]	1999	(123)	(106)	1999	(123)	(106)	2012	(88)	(75)	(88)	(75)
Jasper	1989	188[14]	145	1996	*103	*90	2013	51	41	51	41
Tonquin					**55*	**46*		*38*	*30*	*38*	*30*
Maligne					**40*	**37*		**5*	**5*	**5*	**5*
Brazeau					**8*	**7*		**8*	**6*	**8*	**6*
Banff[15]	1986	*29	*26	1996	*8	*7	2009	0	0	0	0
TOTAL		1548	1310		1434	1237		553	469	553	469

[1] Where survey estimates were not provided in the survey report, the total number counted (minimum count) was used as the survey estimate and population estimate (indicated with an asterix [*]). Source documents for surveys in this table are listed in Appendix 3A.

[2] This survey/estimate is the oldest reliable survey conducted with the highest count of animals during the last 3 generations (27 years)

[3] This survey/estimate is the oldest reliable survey conducted with the highest count of animals during the last 2 generations (18 years)

[4] The number of mature individuals was derived by applying the proportion of adults in the survey to the survey estimate or population estimate

[5] No survey has been conducted for the west side of the Scott range; this estimate was based on anecdotal information and expert opinion and has not been updated so the same estimate was used for the current estimate for the purpose of assessing overall population trend. The number of mature individuals for the west side of the Scott range was derived by applying the proportion of adults during the two surveys in the east side of the Scott range to the west side estimate

[6] Based on observations on the low-elevation winter range during the fall, the minimum population is 22 with an estimated population ranging from 25-35 (with a midpoint of 30). The number of adults was estimated by applying the proportion of adults seen (21/22) to the total population estimate of 30.

[7] No composition data was available for this year so the number of mature individuals was calculated based on the average proportion of adults in all surveys for the subpopulation that included composition data

[8] The last known collared caribou in the Burnt Pine subpopulation died late in 2013 (D. Seip, pers. comm. 2014) and the population estimate at this time is 0; however, ongoing monitoring of the population will confirm whether or not this subpopulation has been extirpated.

[9] 95% confidence interval

[10] Extrapolated from a partial survey. Total population estimated at 98-113 (midpoint=106). The number of adults was estimated by applying the % of adults (82%) in the partial survey to the total estimate.

[11] Population estimates based on 2009 population estimate of 100 caribou and mature estimate of 90 caribou (ASRD&ACA 2010) and then extrapolated back to 2008 using annual lambdas from ASRD&ACA (2010) and extrapolated to 2012 using annual lambdas from Alberta Ministry of Environment and Sustainable Resource Development (unpublished data; 2010: λ=0.983; 2011: λ=0.904; 2012: λ=0.811). Cumulative λ (2008-2012) = 0.55

[12] Population estimates based on 2009 population estimate of 212 caribou and mature estimate of 178 caribou (ASRD&ACA 2010) and then extrapolated back to 1999 using annual lambdas from ASRD&ACA (2010) and extrapolated to 2012 using annual lambdas from Alberta Ministry of Environment and Sustainable Resource Development (unpublished data; 2010: $\lambda=0.866$; 2011: $\lambda=0.921$; 2012: $\lambda=0.749$). Cumulative λ (1999-2012) = 0.27

[13] Population estimates based on 2009 population estimate of 135 caribou and mature estimate of 116 caribou (ASRD&ACA 2010) and then extrapolated back to 1999 using annual lambdas from ASRD&ACA (2010) and extrapolated to 2012 using annual lambdas from Alberta Ministry of Environment and Sustainable Resource Development (unpublished data; 2010: $\lambda=0.836$; 2011: $\lambda=0.880$; 2012: $\lambda=0.835$). Cumulative λ (1999-2012) = 0.71

[14] The subpopulation was estimated to be 175-200 caribou based on a count of 162 in October 1988 (Brown *et al.* 1994)

[15] Data interpreted from Figure 1 in Hebblewhite *et al.* 2010b. Data based on annual maximum counts and telemetry studies. The number of mature individuals was derived by applying the proportion of adults in caribou sightings in that year (Parks Canada, unpublished data) to the total number.

Appendix 3a. Source documents for survey data in the Central Mountain DU (DU8).

Subpopulation	Survey Year for 3 generations (reference)	Survey Year for 2 generations (reference)	Most recent survey year (reference)
Scott East	Giguere and McNay 2007	Giguere and McNay 2007	BC MOE unpublished data
Scott West	S. McNay, pers. comm. 2013	S. McNay, pers. comm. 2013	S. McNay, pers. comm. 2013
Moberly	Wood 1995	Wood and Hengeveld 1998	BC MOE unpublished data
Kennedy Siding	Seip and Jones 2013	Seip and Jones 2013	BC MOE unpublished data
Burnt Pine	TERA 1997	TERA 1997	BC MOE unpublished data
Quintette	Seip and Jones 2011	Seip and Jones 2013	BC MOE unpublished data
Narraway - Bearhole Red-willow	Seip and Jones 2013	Seip and Jones 2013	BC MOE unpublished data
Narraway – other	ASRD&ACA 2010; Alberta ESRD unpublished data	ASRD&ACA 2010; Alberta ESRD unpublished data	ASRD&ACA 2010; Alberta ESRD unpublished data
Redrock-Prairie Creek	ASRD&ACA 2010; Alberta ESRD unpublished data	ASRD&ACA 2010; Alberta ESRD unpublished data	ASRD&ACA 2010; Alberta ESRD unpublished data
A La Peche	ASRD&ACA 2010; Alberta ESRD unpublished data	ASRD&ACA 2010; Alberta ESRD unpublished data	ASRD&ACA 2010; Alberta ESRD unpublished data
Jasper	Brown *et al.* 1994	Parks Canada unpublished data	Parks Canada unpublished data
Tonquin		Parks Canada unpublished data	Parks Canada unpublished data
Maligne		Parks Canada unpublished data	Parks Canada unpublished data
Brazeau		Parks Canada unpublished data	Parks Canada unpublished data
Banff	Brown *et al.* 1994	Hebblewhite *et al.* 2010; Parks Canada, unpublished data	Hebblewhite *et al.* 2010

Appendix 4. Estimates of total numbers and number of mature individuals for subpopulations in Southern Mountain DU (DU9) based on surveys conducted 3 generations ago and 2 generations ago, and on the most recent survey.

	Earliest, highest previous survey estimate within 3 generations (27 years)[1,2]			Earliest, highest previous survey estimate within 2 generations (18 years)[1,3]			Most recent survey/estimate[1]				
								Survey estimate		Population estimate	
Subpopulation	Year	Total	Mature[4]	Year	Total	Mature[4]	Year	Total	Mature[4]	Total	Mature[4]
Columbia North	1997	280 (210-280)	247	1997	280 (210-280)	247	2013	183	157	183	157
Columbia South	1994	114 (106-142)	100	1996	103 (94-112)	90	2013	7	6	7	6
Frisby Boulder	1994	*43	39	1997	*42	37	2013	13	12	13	12
Monashee	1994	*12	8	2004	*8	7	2011	*4	4	*4	4
Nakusp	1996	211 (191-264	192 (172-245)	1996	211 (191-264)	192 (172-245)	2014[5]	64	54	64	54
Duncan	1999	*31	23[6]	1999	*31	23[6]	2012	2	2	2	2
Central Rockies	1995	*30	28	1997	*25	24	2008	3	4	3	4
Purcells South	1995	69	63	1996	56	56	2014	23	22	23	22
Purcells Central	1994	*22	19	1996	*22	20	2005	0	0	0	0
South Selkirks	1995[7]	*63	53	1999	*58	50[6]	2014	22	20	22	20
George Mountain	1993	*24	22[8]	1999	*7	6[8]	2004	0	0	0	0
Groundhog	1990	109	89	1999	31	25	2013	*13	11	*13	11
Wells Gray	1995	631	522	2006	481	402	2013	343	298	392	341
Wells Gray South	*1995*	*336*	*276*	*2006*	**242*	*203*	*2013*	**133*	*112*	**133*	*112*
Wells Gray North	*1995*	*295 (256-398)*	*246*	*2006*	*239 (212-375)*	*199*	*2013*	*210*	*186*	*259*	*229*
Barkerville	1988	*46	39	1997	50 (50-129)	40	2012	88	76	90	78
Narrow Lake	1999	81	73	1999	81	73	2014	47	45	47	45
North Cariboo Mountains	1999	*299	280	1999	*299	280	2011	222	202	222	202
Hart Ranges	2006	716	590	2006	716	590	2013	439	381	459	398
Parsnip	*2006*	*230*	*183*	*2006*	*230*	*183*	*2013*	*101*	*88*	*121*	*105*
Hart Ranges South	*2006*	*486*	*407*	*2006*	*486*	*407*	*2013*	*338*	*293*	*338*	*293*
TOTAL		2781	2387		2501	2162		1473	1294	1544	1356

[1] Censuses of DU9 caribou are conducted using standardized methods and searching predetermined survey areas. Various techniques have been used to estimate number of caribou in the survey area (survey area estimate) and for the whole population (population estimate). For surveys where no radio-collared caribou are present, the survey estimate is usually equivalent to the population estimate. For surveys where radio-collared caribou are available, caribou are sometimes found outside of the survey area – animals found outside of the survey area are then incorporated into the population estimate but not the survey estimate. In this table, survey estimates are presented for assessing population trend, and the most recent population estimate is presented for assessing the current population size of caribou in DU9. For surveys where a survey estimate was not provided in the report (indicated with an asterix [*]), the estimate was calculated by applying a standardized sightability correction factor of 0.83 used for DU9 caribou surveys based on Seip (1990) and Young and Roorda (1999) to total caribou seen plus tracks. Numbers in parentheses are 90% confidence intervals, except for Wells Gray North and Barkerville, which are 95% confidence intervals. Source documents for surveys in this table are listed in Appendix 4A.

[2] This survey/estimate is the oldest reliable survey conducted with the highest count of animals during the last 3 generations (27 years)

[3] This survey/estimate is the oldest reliable survey conducted with the highest count of animals during the last 2 generations (18 years)

[4] The number of mature individuals was derived by applying the proportion of adults in the survey to the survey estimate or population estimate, except for the 1996 Nakusp survey where an estimate of mature individuals was provided

[5] This survey includes the Duncan subpopulation but the data for each subpopulation was not available at the time of publication

[6] No composition data was available for this year so the number of mature individuals was calculated based on the average proportion of adults in all surveys for the subpopulation that included composition data

[7] This survey was considered incomplete but it had the highest number of caribou counted in that time period

[8] No composition data was available for this year; the only year composition was available was 2002 so the number of mature individuals was calculated based on the average proportion of adults in all surveys for the nearby Narrow Lake subpopulation that included composition data

Appendix 4a. Source documents for survey data in the Southern Mountain DU (DU9)

Subpopulation	Survey Year for 3 generations (reference)	Survey Year for 2 generations (reference)	Most recent survey year (reference)
Columbia North	1997 (McLellan *et al.* 2008)	1997 (McLellan *et al.* 2008)	2013 (BC MFLNRO unpublished data)
Columbia South	1994 (McLellan *et al.* 2008)	1996 (McLellan *et al.* 2008)	2013 (BC MFLNRO unpublished data)
Frisby Boulder	1994 (McLellan *et al.* 2008)	1997 (McLellan *et al.* 2008)	2013 (BC MFLNRO unpublished data)
Monashee	1994 (McLellan *et al.* 2008)	2004 (McLellan *et al.* 2008)	2011 (Furk *et al.* 2011)
Nakusp	1996 (Hamilton *et al.* 2000)	1996 (Hamilton *et al.* 2000)	2014 (BC MFLNRO unpublished data)
Duncan	1999 (Hamilton *et al.* 2000)	1999 (Hamilton *et al.* 2000)	2012 (DeGroot and Furk 2012)
Central Rockies	1995 (McLellan *et al.* 2008)	1997 (McLellan *et al.* 2008)	2008 (McLellan *et al.* 2008)
Purcells South	1995 (BC MFLNRO unpublished data)	1996 (BC MFLNRO unpublished data)	2014 (BC MFLNRO unpublished data)
Purcells Central	1994 (BC MFLNRO unpublished data)	1996 (BC MFLNRO unpublished data)	2005 (Kinley 2006)
South Selkirks	1995 (Wakkinen 2003)	1995 (Wakkinen 2003)	2014 (BC MFLNRO unpublished data)
George Mountain	1993 (Watts 1999)	1999 (Watts 1999)	2004 (Seip *et al.* 2004)
Groundhog	1990 (Hatter 2006)	1999 (Hatter 2006)	2013 (BC MFLNRO unpublished data)
Wells Gray South	1995 (Scheer 1995)	2006 (BC MFLNRO unpublished data)	2013 (BC MFLNRO unpublished data)
Wells Gray North	1995 (Freeman 2012)	2006 (Freeman 2012)	2013 (Mackay 2013)
Barkerville	1988 (Freeman 2012)	1997 (Freeman 2012)	2012 (Freeman 2012)[1]
Narrow Lake	1999 (Watts 1999)	1999 (Watts 1999)	2014 (Courtier and Heard 2014)
North Cariboo Mountains	1999 (Watts 1999, Young and Freeman 2001b)	1999 (Watts 1999, Young and Freeman 2001b)	2011 (Seip *et al.* 2011)
Hart Ranges (Parsnip only)	2006 (Seip *et al.* 2006)	2006 (Seip *et al.* 2006)	2013 (Heard *et al.* 2013)
Hart Ranges (south only)	2006 (Seip *et al.* 2006)	2006 (Seip *et al.* 2006)	2013 (Heard *et al.* 2013)[2]
Hart Ranges total	2006 (Seip *et al.* 2006)	2006 (Seip *et al.* 2006)	2012 (Heard *et al.* 2013)

[1] The 2013 survey was incomplete so the 2012 survey data is used here

[2] Although this survey was incomplete in the southern portion of the Hart Ranges, an estimate for the southern portion of the Hart Ranges was extrapolated based on the proportion of the previous year's totals that were seen in fully surveyed portions of Hart Ranges South (Heard *et al.* 2013).

Appendix 5. Threats calculator results for Northern Mountain Caribou DU (DU7)

Species or Ecosystem Scientific Name	*Rangifer tarandus caribou*
Element ID	DU 7
Date	14/11/2013
Assessor(s):	Chris Ritchie, BC FLNR, Fish & Wildlife Recovery, Victoria, Fish and Wildlife Recovery Implementation Manager; Conrad D. Thiessen, BC FLNRO, Fish & Wildlife Branch, Smithers, Wildlife Biologist; Jocelyn Campbell, BC FLNR, Fish & Wildlife Branch, Smithers, Ecosystems Biologist; Chris Nowotny, BC FLNR, Land Resource Management - Cariboo, Senior Habitat Management Biologist; Pat Dielemna, BC FLNR, Wildlife Biologist; Joanne McLeod, BC FLNR, Resource Management - Cariboo Regional Operations, Habitat Biologist, Chilcotin and Likely; Becky Cadsand, BC FLNRO, Wildlife Biologist, Cariboo Region; Troy Hegel, Yukon Gov, Species Programs, Ungulate Biologist (Caribou/ Sheep/ Goat); Tom Jung, Yukon Gov, Biodiversity Programs, Senior Wildlife Biologist (Biodiversity); Suzanne Carriere, NWT Wildlife Biologist (Biodiversity); Joanna Wilson, NWT Wildlife Biologist (Species at Risk); Nic Larter Dehcho, NWT Manager, Wildlife Research and Monitoring; Richard Popko Sahtu, NWT Manager, Wildlife Research and Monitoring; Justina Ray, Co-chair of the COSEWIC Terrestrial Mammals Specialist Subcommittee; Donna Bigelow, Environment Canada, Species at Risk Biologist; Dave Fraser, BC FLNRO, Threats Assessment Facilitator; Greg Ferguson, Environment Canada, Species at Risk Biologist, Conference Call Coordinator; Deb Cichowski, Consultant on contract with Environment Canada; Line Giguere, Wildlife Infometrics Inc.; Chris Johnson, UNBC and COSEWIC Terrestrial Mammals Specialist Subcommittee.

Overall Threat Impact Calculation Help:

		Level 1 Threat Impact Counts	
Threat Impact		**high range**	**low range**
A	Very High	0	0
B	High	0	0
C	Medium	1	0
D	Low	6	7
Calculated Overall Threat Impact:		High	Medium

Threat		Impact (calculated)	Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
1	Residential & commercial development	Negligible	Negligible (<1%)	Slight (1-10%)	High (Continuing)	
1.1	Housing & urban areas	Negligible	Negligible (<1%)	Slight (1-10%)	High (Continuing)	YT: community of Whitehorse has and is expected to have impacts on Carcross herd (i.e., winter range impacts from land applications - rural residential). NT: not a major impact. BC: community of Atlin has and is expected to have impacts on Atlin herd. Some impact to Telkwa and Itcha-Ilgachuz herds in west-central BC.
2	Agriculture & aquaculture	Negligible	Negligible (<1%)	Slight (1-10%)	High (Continuing)	
2.1	Annual & perennial non-timber crops	Negligible	Negligible (<1%)	Slight (1-10%)	High (Continuing)	YT: activity - hay crops. Overall negligible impact. BC: herds directly impacted - Telkwa, Graham. Overall negligible impact. Severity: localized habitat loss
2.3	Livestock farming & ranching	Unknown	Small (1-10%)	Unknown	High (Continuing)	YT and BC: more widespread with guide outfitters with horses in backcountry, all herds have some presence. Significant numbers of feral horses in the Itcha-Ilgachuz range around Anahim Lake; cattle grazing in Itcha-Ilgachuz

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
3	Energy production & mining	D	Low	Small (1-10%)	Slight (1-10%)	High (Continuing)	
3.1	Oil & gas drilling	D	Low	Small (1-10%)	Slight (1-10%)	High (Continuing)	Scope: YT and NWT: not prevalent. BC: overall low (part of Graham, Muskwa, Liard Plateau, Pink Mountain herds). The score reflects only direct mortality from the activity and not the change in alternate prey/predators. This activity contributes to impacts from other related threats (e.g., wolves).
3.2	Mining & quarrying	D	Low	Small (1-10%)	Slight (1-10%)	High (Continuing)	Scope: YT: small direct impact. NT: one active mine in the range of the Redstone and Nahanni herds and 1 inactive mine that will likely become active within the next 10y. BC: operating and proposed mines happening in all ranges in NE (e.g., Liard Plateau, Muskwa, Graham, Pink Mountain) and in Edziza, Spatsizi, Level Mountain. Proposed mine in Tweedsmuir range. NW transmission line will facilitate new mines.
3.3	Renewable energy		Negligible	Negligible(<1%)	Slight(1-10%)	High (Continuing)	Scope: YT: negligible. NWT: nothing now. BC: wind in Graham, Pink Mountain. Severity: Severity: BC: concern to habitat for Graham herd.
4	Transportation & service corridors	D	Low	Restricted (11-30%)	Moderate (11-30%)	High (Continuing)	
4.1	Roads & railroads	D	Low	Restricted (11-30%)	Moderate (11-30%)	High (Continuing)	Scope: YT: lower end of 11-30% rating. NT: very small scope. BC: Itcha-Ilgachuz herd will be subjected to extensive road development and logging traffic throughout most of their winter range over the next 10y. Low end of 1-10% for Muskwa, Pink Mountain, and Tsenaglode herds. Chase and Wolverine 30-70%, Takla 11-30%. No roads in Spatsizi, Frog, Gataga, minimal in Charlotte Aplands. Severity: impact is from caribou displaced by roads and direct impact (e.g., loss of habitat, hits). YT: there are hot spots for road kill. NT: no road impacts. BC: Itcha-Ilgachuz could see major increase in winter truck traffic in winter range. Based on combining existing and future threats of roads in entire DU, ranked as Moderate (11-30%).
4.2	Utility & service lines		Negligible	Small (1-10%)	Negligible (<1%)	High (Continuing)	Scope: YT: negilible or low end of small, new hydro lines going in or proposed. NWT: future impact of existing telegraph line is negligible (<1%) for Redstone herd. BC: pipelines and hydro lines going through herds. Expected 11-30% scope for Chase and Wolverine. Telkwa, Muskwa, Graham and Pink Mountain herds will be impacted by pipeline and hyrdo line. Spatsizi, Tsenaglode and Horseranch likely to be impacted by pipeline. Takla an unknown concern. Severity: Mechanism felt to be less than the impact from mining. General: examples of impacts: hydro right-of-ways, pipelines.
4.4	Flight paths						YT, NT, and BC: no concerns (directly speaking to regular aircraft flight paths)

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
5	Biological resource use	D	Low	Small (1-10%)	Moderate - Slight (1-30%)	High (Continuing)	
5.1	Hunting & collecting terrestrial animals	D	Low	Pervasive (71-100%)	Slight (1-10%)	High (Continuing)	Scope: YT: pervasive, outfitters go everywhere; BC: Overall no hunting in southern part of range. Harvest is allowed in Itcha-Ilgachuz, Chase and Wolverine herds. Severity: YT: slight (2-3% harvest rate), some herds in decline because of harvest. NT: negligible. BC: quotas often go underutilized and some FN hunt. Hunting pressure may increase with caribou shifting to more settled and accessible areas and with decreases in moose populations.
5.3	Logging & wood harvesting	D	Low	Small (1-10%)	Moderate - Slight (1-30%)	High (Continuing)	Scope: YT: negligible. NWT: zero to neglible. BC: Liard Plateau, Pink Mountain, Itcha-Ilgachuz, Telkwa, Graham, Tweedsmuir, Chase (large due to pine beetle logging), Wolverine 71-100%. Itcha-Ilgachuz herd will be subjected to extensive logging throughout most of their winter range over the next 10 years. Severity: for Itcha-Ilgachuz herd forest harvesting occurs in the winter over half of their winter range with direct disturbance and increasing risk to wolf predation.
6	Human intrusions & disturbance	D	Low	Large (31-70%)	Slight (1-10%)	High (Continuing)	
6.1	Recreational activities	D	Low	Large (31-70%)	Slight (1-10%)	High (Continuing)	Scope: YT: small, few herds have heavy pressure. Aishihik herd threatened in relation to bison hunting and other herds threatened by recreational hunting for other non-caribou game species. NT: small, sport hunting and eco-tourism can cause impact. BC: all herds are impacted by recreational activities, 11-30%. Severity: Yukon: don't know precisely, but winter activity (e.g., snowmobiling) a known concern. BC: Snowmobiling a concern in BC for Itcha-Ilgachuz, Telkwas, Rainbow, Charlotte Alplands).
6.3	Work & other activities		Negligible	Pervasive (71-100%)	Negligible (<1%)	High (Continuing)	Scope: Yukon: pervasive. NWT: high. BC: all herds implicated. Severity: Yukon: exploration and helicopter impacts (low end of slight, but not negligible), not all animals impacted. NWT: negligible, as same impacts seen in Yukon aren't present. BC: negligible (e.g., Itcha-Ilgachuz). Threats considered from flights in and out of mining camps, biological/geological surveys, etc.
7	Natural system modifications	D	Low	Pervasive (71-100%)	Slight (1-10%)	High (Continuing)	
7.1	Fire & fire suppression	D	Low	Pervasive (71-100%)	Slight(1-10%)	High (Continuing)	Scope: YT, NT and BC: all herds exposed and likely to be impacted. Some NE BC herds subjected to prescribed burning for other species. YT: pervasive. BC: Chase and Wolverine will experience fires. Severity: can depend on intensity of fire. Lichen loss could be great with downed beetle killed pine. Lichen recovery won't happen in time frame of assessment. Also impacts to herds via habitat alienation.

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
7.2	Dams & water management/use		Negligible	Small (1-10%)	Negligible (<1%)	High (Continuing)	Existing dams have resulted in a significant permanent loss of habitat where they occured in caribou habitat. Scope: YT and NT: no impact expected. BC: no impact from Site C as caribou don't cross area. Williston Reservoir cuts caribou off (loss of connectivity, dispersal). Tweedsmuir caribou cross the Nechako reservoir and may be prone to drowning Severity: there may be some decreased dispersal and connectivity due to existing dams that is an ongoing threat.
7.3	Other ecosystem modifications	D	Low	Large - Restricted (11-70%)	Slight (1-10%)	High (Continuing)	Scope: YT: mountain pine beetle likely to come north and could have a potential impact. Spruce bark beetle a concern. Range expansion of a number of new species in last century (e.g., mule deer, moose, elk). NT: negligible. BC: problem of mountain pine beetle still ongoing. Severity: General: some uncertainty of overall impact to caribou numbers. Yukon: believed to be small. NWT: negligible. BC: changes to habitat creating better habitat for alternate prey. Temporary loss of lichen over large area.
8	Invasive & other problematic species & genes	CD	Medium - Low	Pervasive (71-100%)	Moderate - Slight (1-30%)	High (Continuing)	
8.1	Invasive non-native/alien species		Unknown	Unknown	Unknown	High (Continuing)	Severity: YT: non-native species are known to be present and there could be potential implications of these species increasing, also climate change could contribute to range expansion and population. Overall not a known driver in caribou declines, but are present. Increasing # degree days and/or stress likely to drive disease increase and damage.
8.2	Problematic native species	CD	Medium - Low	Pervasive (71-100%)	Moderate - Slight (1-30%)	High (Continuing)	Severity: Overall: not a lot of knowledge about presence and impact of problematic species (e.g., predators such as wolves, bears, wolverines, etc.) for many northern herds in DU (data deficient). Only herds for which there is more information are the southern herds where wolf/cougar predation is the chief proximate threat; it is associated with other impacts (e.g., roads, pipelines, forest harvesting, altered predator/prey relationships).
10	Geological events	D	Low	Restricted (11-30%)	Slight (1-10%)	High (Continuing)	
10.3	Avalanches/landslides	D	Low	Restricted (11-30%)	Slight (1-10%)	High (Continuing)	Scope: YT: negligible, herds don't usually occur in this type of habitat. NT: negligible. BC: avalanches a concern (e.g., Peace region, Telkwa, Chase, Wolverine, Takla). Severity: Yukon and NWT: negligible. BC: one event could have a large impact (e.g., loss of a herd or majority of individuals).
11	Climate change & severe weather		Unknown	Pervasive - Large (31-100%)	Unknown	High (Continuing)	
11.1	Habitat shifting & alteration		Unknown	Pervasive - Large (31-100%)	Unknown	High (Continuing)	Scope: all of YT and NWT. Yukon: definitely habitat shifting (e.g., losing snow pack conditions, permafrost melting in NT, earlier springs, changes in phenology, alpine areas are getting shrubbier). Severity: Unknown for

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
							Yukon and NWT.
11.4	Storms & flooding		Unknown	Large - Restricted (11-70%)	Unknown	High (Continuing)	Scope: YT: can happen anywhere in territory (e.g., rain on snow events, warm up and freezing in May). NT: no historical or current data on occurrence of threat available. BC: freeze thaw events are similar or may be happening more, but hard to say without more data and monitoring (i.e., not well documented).

Appendix 6. Threats calculator results for Central Mountain Caribou DU (DU8)

Species or Ecosystem Scientific Name	*Rangifer tarandus caribou*
Element ID	DU8
Date:	15/11/2013
Assessor(s):	Chris Ritchie, BC FLNR, Fish & Wildlife Recovery, Victoria, Fish and Wildlife Recovery Implementation Manager; Chris Pasztor, BC MOE, Ecosystem Branch; Dale Seip, BC FLNRO, Wildlife Biologist; Dave Hervieux, AB Min Envir & Sustain Resources Dev, Fisheries and Wildlife Management, Fisheries and Wildlife Program Manager; Darcy Peel, Interchange with Environment Canada, Species at Risk Biologist; Greg Wilson, Environment Canada - PNR, A/Head SAR Recovery, formerly SAR Biologist; Mark Bradley, Jasper and Geoff Skinner, Parks Canada; Deborah Cichowski, Consultant on contract with Environment Canada; Dave Fraser, BC FLNRO, Threats Assessment Facilitator; Greg Ferguson, Environment Canada, Species at Risk Biologist, Conference Call Coordinator

Overall Threat Impact Calculation Help:

		Level 1 Threat Impact Counts	
Threat Impact		high range	low range
A	Very High	1	1
B	High	0	0
C	Medium	1	1
D	Low	6	6
Calculated Overall Threat Impact:		Very High	Very High

Overall Threat Comments

General Introductory Discussion: clarification of threat assessment (i.e., proximate or direct threat versus indirect; e.g., habitat loss is direct, but the indirect result is a threat from changes to ecological interactions within the system). The IUCN threats assessment makes it very difficult to account for related and synergistic impacts, as the threats are assessed separately/individually (e.g., for southern and central caribou, habitat change through logging and wood harvesting is assessed separately as a direct impact, but this change leads to increased prey, which leads to increased predators (wolves, cougar, bear) that ultimately kill caribou). Caribou experts questioned the adequacy of using the IUCN process for assessing the threats to caribou, especially in regards to the severity of the impact, as it is difficult to parse out all the details between related threats. Dave Fraser commented that this assessment method is the most widely used in the world for species conservation and is the best we have at this time. Darcy Peel commented that concerns about related and synergistic threats needs to be captured, addressed and highlighted, where appropriate, in the description of threats section of the recovery strategy to ensure the reader understands the interactions and implications of threats to caribou.

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
1	Residential & commercial development	D	Low	Small (1-10%)	Slight (1-10%)	High (Continuing)	
1.3	Tourism & recreation areas	D	Low	Small (1-10%)	Slight (1-10%)	High (Continuing)	Scope: Jasper: Marmot Basin ski resort has requested to expand. This herd covers more than 1% of DU's range, with a size of 54 mature individuals (~10% of total DU population). AB and BC: not a concern. Severity: slight.
3	Energy production & mining	C	Medium	Large (31-70%)	Moderate (11-30%)	High (Continuing)	

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
3.1	Oil & gas drilling	D	Low	Pervasive (71-100%)	Slight (1-10%)	High (Continuing)	Threats may include removal of habitat, reduced use, avoidance, changes in movement, or proximity impacts. Scope: AB: all animals impacted except those in Jasper. BC: half of range impacted, including the Narraway (low-elevation habitats) and Quintette herds. Herds impacted are ~75% of total population. Severity: AB: suggested rate the same as timber harvesting.
3.2	Mining & quarrying	C	Medium	Large (31-70%)	Moderate (11-30%)	High (Continuing)	Threats may include expanding or new activities in next 10 years. Scope: AB: Redrock-Prarie Creek and A La Peche impacted. BC: 65% of caribou in BC (Narraway and Quintette anticipated coal mining). Severity: BC: there is an expected direct loss of limited habitat.
3.3	Renewable energy	CD	Medium - Low	Large (31-70%)	Moderate - Slight (1-30%)	Moderate (Possibly in the short term, < 10 yrs/3 gen)	General Comments: threat included wind farms. Scope: AB: all ridges where caribou exist are being investigated for wind. BC: extensive areas are being investigated for wind power. Likelihood of all tenures being developed is uncertain but believed to be low. To date, BC has been able to move wind projects to low or non-risk areas. Potentially a third of caribou impacted. Severity: AB and BC: there is uncertainty/speculation about how many will be developed and thus the severity of impact. In BC, tenures are in windswept alpine areas and if approved would have an impact.
4	Transportation & service corridors	D	Low	Pervasive (71-100%)	Slight(1-10%)	High (Continuing)	
4.1	Roads & railroads	D	Low	Pervasive (71-100%)	Slight (1-10%)	High (Continuing)	General: threats may include road construction, avoidance of roads, and being hit. Scope: all ranges implicated, but roads of concern are primarily those being built for oil and gas. Severity: AB and BC: minor.
4.2	Utility & service lines		Negligible	Restricted (11-30%)	Negligible (<1%)	High (Continuing)	General Comments: primarily considered pipelines and hydro lines. Scope: AB: 70-100%. BC: pipelines go through valley bottoms. For the most part, the Narraway herd being an exception, this is an unused area of habitat by caribou. Pipelines existing or proposed are likely within proximity to every herd. A powerline is already present for the Kenny Siding herd.
4.4	Flight paths						General: threat considered was regularly scheduled flights.
5	Biological resource use	D	Low	Large (31-70%)	Slight (1-10%)	High (Continuing)	
5.1	Hunting & collecting terrestrial animals		Negligible	Pervasive - Large (31-100%)	Negligible (<1%)	High (Continuing)	Scope: AB: all caribou exposed to poaching or First Nations hunting, except Jasper. Few caribou known to be actually taken, but poaching always a potential concern. BC: no licensed sport hunting allowed, no evidence of First Nations harvest or poaching. Severity: AB and BC both agree <1%
5.3	Logging & wood harvesting	CD	Medium - Low	Large (31-70%)	Moderate - Slight (1-30%)	High (Continuing)	General Comment: threat is direct impact of logging (i.e., what harvesting is present or will actually or is predicted to happen within 10 years and its impact on caribou over 3 generations within the scope of its occurrence). Scope: AB and Parks Canada: all of the area. South Jasper caribou don't leave the park, but North Jasper do. A La Peche go into logged habitat. BC: in valley bottoms not a direct impact except in Narraway, Quintette and Kennedy Siding. However, the primary habitat alteration that indirectly harms caribou. ~30% of the caribou have direct logging impacts. Overall: total for DU is 31-70%. Severity: AB: caribou forced into sub-optimal habitat (e.g., deeper snow, avalanch terrain) and experience reduced

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
							body condition and increased risks of accidents. Higher concern for AB - moderate severity. BC: negligible. Harvesting not to occur in tree lichen forest, thus caribou are not starving because of logging.
6	Human intrusions & disturbance	D	Low	Pervasive (71-100%)	Slight (1-10%)	High (Continuing)	
6.1	Recreational activities	D	Low	Pervasive (71-100%)	Slight (1-10%)	High (Continuing)	General Comments: threats may include snowmobiles, ATVs, hiking, heli-skiing, and helicopter or fixed wing access to backcountry areas. Impacts include direct mortality, chronic stress resulting in death, reduced reproduction, pushed into areas of harm (avalanch areas). Scope: AB and BC: all herds. Severity: AB: negligible. Parks Canada: potential for displacement of caribou due to tourism (severity slight). BC: not a lot of recreation areas that overlap with caribou range.
6.3	Work & other activities	D	Low	Pervasive (71-100%)	Slight (1-10%)	High (Continuing)	General Comments: threats may include survey flights for work purposes or other on-ground activities associated with work. Examples of impacts could include habitat loss or displacement of animals. Scope: AB: large, especially from activities associated with oil and gas development (e.g., surveying by people and other associated activities, blasting, sampling, drilling, running survey lines - 3D seismic in winter).
7	Natural system modifications	D	Low	Pervasive (71-100%)	Slight (1-10%)	High (Continuing)	
7.1	Fire & fire suppression		Not Calculated (outside assessment timeframe)	Small (1-10%)	Moderate - Slight (1-30%)	Low (Possibly in the long term, >10 yrs/3 gen)	Scope: AB: no fire risk due to fire supression and extensive logging. Jasper: looking to avoid fires, but forests are older so is a potential concern but uncertain. BC: not a big concern, with the Narraway herd at most risk but minor. Limited fire supression in caribou ranges. Small 1-10%. Severity: AB and BC: where it occurs is moderate to slight.
7.2	Dams & water management/use		Negligible	Small (1-10%)	Negligible (<1%)	High (Continuing)	Threat includes the impact of existing dams and new dams. Existing dams have resulted in a significant permanent loss of habitat where they occured in caribou habitat. Scope: could be a threat to Scott herd since the Williston reservoir bisects a large part of their range. No new dams are expected in DU in next 10 years. Ranked as small. Severity: there may be some decreased dispersal, connectivity, and mortality (drowning) due to Williston reservoir as an ongoing threat. Ranked as negligible. Timing: high (continuing).
7.3	Other ecosystem modifications	D	Low	Pervasive (71-100%)	Slight (1-10%)	High (Continuing)	Threat considered mountain pine beetle and loss of habitat and forage and displacement of animals as direct impact. Indirect impact is changes in habitat that result in increased prey and predators. Scope: AB: not as much pine and impact. Jasper: not a large concern. BC: only ~30% are exposed to pine forests (Kennedy and Narraway herds). Severity: BC: temporary impact to population due to short-term decline in lichen, but not a major concern for longterm.
8	Invasive & other problematic species & genes	A	Very High	Pervasive (71-100%)	Extreme (71-100%)	High (Continuing)	

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
8.1	Invasive non-native/alien species		Unknown	Unknown	Unknown	Moderate (Possibly in the short term, < 10 yrs/3 gen)	Chronic wasting disease was the main concern raised as an alien species having been introduced via game farming.
8.2	Problematic native species	A	Very High	Pervasive(71-100%)	Extreme(71-100%)	High (Continuing)	Threat considered was direct mortality due to predators (e.g., wolves, bear, cougar) and/or the influence they have on caribou (e.g., displacement, increased movement, stress, reduced body condition). However, increased predation was directly related to increased prey populations (e.g., white tailed deer) resulting from an increase in early seral forest due to considerable developement in the area (i.e., forest harvesting, mining, oil and gas activities). Recreational trails (e.g., ski/snomobile) also a contributing factor as they provide access for predators to caribou. Fire mostly a concern for herds in federal parks. Climate change a possible factor. Scope: pervasive. Severity: extreme (71-100). This is a significant threat to the persistence of caribou in this DU. Concern that there are no large herds to dampen impact, unlike DU7. Very few caribou will remain if this threat is not addressed in a timely and significant way.
9	Pollution		Negligible	Pervasive (71-100%)	Negligible (<1%)	High (Continuing)	
9.6	Excess energy		Negligible	Pervasive (71-100%)	Negligible (<1%)	High (Continuing)	General Comment: threat considered was noise (compressor stations, flare stacks considered in oil and gas). Scope: AB: everything. BC: Narraway and Quintette. Severity: AB: low impact. Agreement to rank the same as oil and gas.
10	Geological events	D	Low	Small (1-10%)	Slight (1-10%)	High (Continuing)	
10.3	Avalanches/landslides	D	Low	Small (1-10%)	Slight (1-10%)	High (Continuing)	General: Scope: ~6% of mortality for Jasper herds was due to avalanches. In the Banff area the last 5 caribou were extirpated in 1 avalanche.
11	Climate change & severe weather		Not Calculated (outside assessment timeframe)	Unknown	Unknown	Low (Possibly in the long term, >10 yrs/3 gen)	
11.1	Habitat shifting & alteration		Not Calculated (outside assessment timeframe)	Unknown	Unknown	Low (Possibly in the long term, >10 yrs/3 gen)	Next 10 years probably not a significant change; likely reduction of alpine meadows in the long term. AB: not a concern.

Appendix 7. Threats calculator results for Southern Mountain Caribou DU (DU9)

Species or Ecosystem Scientific Name	*Rangifer tarandus caribou*
Element ID	DU9
Date:	13/11/2013
Assessor(s):	Chris Ritchie, BC FLNRO, Fish & Wildlife Recovery, Victoria, Fish and Wildlife Recovery Implementation Manager; Chris Pasztor, BC MOE, Ecosystem Branch; John Surgenor, BC FLNRO, Ecosystems Branch, Kamloops, Wildlife Biologist; Darcy Peel, Interchange with Environment Canada, Species at Risk Biologist; Kelsey Furk, Parks Canada, Wildlife Biologist; Danielle Backman, Parks Canada, Glacier National Park; Deborah Cichowski, Consultant on contract with Environment Canada; Justina Ray, Co-chair of the COSEWIC Terrestrial Mammals Specialist Subcommittee; Dave Fraser, BC FLNRO, Threats Assessment Facilitator; Greg Ferguson, Environment Canada, Species at Risk Biologist, Conference Call Coordinator

Overall Threat Impact Calculation Help:

		Level 1 Threat Impact Counts	
Threat Impact		**high range**	**low range**
A	Very High	1	1
B	High	0	0
C	Medium	3	1
D	Low	3	5
Calculated Overall Threat Impact:		Very High	Very High

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
2	Agriculture & aquaculture		Negligible	Negligible (<1%)	Slight (1-10%)	High (Continuing)	
2.1	Annual & perennial non-timber crops		Negligible	Negligible (<1%)	Slight (1-10%)	High (Continuing)	Threat is from direct impact of non-timber crops (e.g., agricultural fields) on caribou survival in next 10 years. Does not include increases in alternate prey. Severity: Parks Canada is negligible. BC: slight at most.
2.3	Livestock farming & ranching		Negligible	Small (1-10%)	Negligible (<1%)	High (Continuing)	Considered the threats of cows (low) and horses (a bit higher).
3	Energy production & mining	D	Low	Restricted - Small (1-30%)	Moderate (11-30%)	High (Continuing)	
3.1	Oil & gas drilling		Negligible	Negligible (<1%)	Unknown	Moderate (Possibly in the short term, < 10 yrs/3 gen)	Scope: shale gas potentially in the Kootenays; but low in the next 10 years.
3.2	Mining & quarrying	D	Low	Small (1-10%)	Moderate (11-30%)	High (Continuing)	General Comments: included the threats of noise and dust and risk of death or diminished capability on active or new mines from footprint, facilities and associated human activity. Scope: restricted occurrence. BC: some in Kootenays, Barkerville, and exploration in some Kamloops areas. Parks Canada comment: exploration overlaps with some calving ranges. Ruddock mine northwest of Revelstoke has proposed expansion. Severity: moderate. BC: severity is moderate or perhaps higher.

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
3.3	Renewable energy	D	Low	Restricted - Small (1-30%)	Moderate (11-30%)	Moderate (Possibly in the short term, < 10 yrs/3 gen)	General Comments: Threats included Independent Power Projects (IPPs) (i.e., run-of-river and wind projects) and impacts of disturbance and displacement via construction, footprint and operation (noise, access). Does not include roads as this is covered under threat 4.1. Scope: BC: there are quite a few run-of-river projects proposed for the North Thompson, but small footprint and mainly in low-elevation areas; some run-of-river projects in place but not yet in caribou habitat. DU wide: there is a considerable amount of uncertaintry regarding the extent of IPP developments and footprints in the next decade. Wind: no wind projects currently proposed for entire DU in caribou habitat. Possible impacts to sensitive habitats (e.g., calving sites) through improper siting. Severity: BC: moderate (risk of death or diminished capability on a windmill site is less than at a mine and more than on a wheat field). Following expert comments, adjusted scope from Small (1-10%) to Restricted-Small (1-30%) and severity from Slight (1-10%) to Moderate (11-31%).
4	Transportation & service corridors	CD	Medium - Low	Pervasive (71-100%)	Moderate - Slight (1-30%)	High (Continuing)	
4.1	Roads & railroads	CD	Medium - Low	Pervasive (71-100%)	Moderate - Slight (1-30%)	High (Continuing)	General Comments: threats include effects of existing and new roads on habitat availability (direct loss) and use (avoidance, barriers to movement/fragmentation) and direct mortality (vehicle collisions/road kills) and reduced fitness (ingestion of salts). Note: resource roads are the main conduit for recreational access (e.g., snowmobile) and possible predator movement. Severity: potential twinning of Trans Canada Highway may make threat worse. Real risk of a large group of caribou being killed by a truck on the Mica Highway in the next 10 years. Groups of 20+ congregate on the highway. 6.5% (3 of 46 caribou) of the South Selkirk population was killed during the winter of 2008/2009 (truck killed a mature bull Oct 2008 and a car killed two cows March 2009) on Highway 3 at Kootenay Pass, of which 7km is in core caribou habitat (also called Salmo-Creston Highway or a segment of the Crowsnest Highway) and there is a risk more could be killed. Following expert comments, adjusted severity from Negligible (<1%) to Moderate-Slight (1-30%).
4.2	Utility & service lines	D	Low	Small (1-10%)	Slight (1-10%)	High (Continuing)	General Comments: considered threats from existing and new utility and service lines (IPPs, pipelines) on habitat availablity (direct loss) and use (avoidance, barriers to movement/fragmentation). Indirect threats not ranked here, but noted include increased habitat for moose and facilitation of snowmobile access into caribou habitat (e.g., one access point could open up a large area of late winter caribou habitat to snowmobile disturbance). Scope: BC: North Thompson some new powerlines proposed; Kinder Morgan pipeline planned to go through North Thompson but in valley bottom; other pipelines proposed further north. Severity: IPP transmission lines could impact habitat directly (e.g., will be permanent early seral non-lichen producing habitat).
4.4	Flight paths						General Comments: threats considered included predictable/regular flights in and out of area (e.g., commercial flight paths in and out of airports). Dealt with heli-skiing flight paths under recreation.
5	Biological resource use	CD	Medium - Low	Large - Restricted (11-70%)	Moderate - Slight (1-30%)	High (Continuing)	
5.1	Hunting & collecting terrestrial animals		Negligible	Pervasive (71-100%)	Negligible (<1%)	High (Continuing)	Scope: potential occurrence throughout the DU, although some areas are inaccessible. Note: increased roads could facilitate more access. Severity: there are a few cases of illegal harvest (2/165 mortalities between 1984 and 2004 in 15 of 17 subpopulations - Wittmer *et al.* 2005). Based on expert comment, added scope of Pervasive, severity of Negligible, and timing as High.

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
5.3	Logging & wood harvesting	CD	Medium - Low	Large - Restricted (11-70%)	Moderate - Slight (1-30%)	High (Continuing)	General Comments: threat only assessed based on habitat loss and not predation. Only considered new logging, not past logging. Scope: BC: two million hectares of high-elevation habitat is protected and impact to this is expected to be small (<10%, some possible for mining). Timber harvesting is expected to occur in habitats used by caribou in the Revelstoke area and further north rather than in seasonal habitats used in other areas of the DU. Severity: most of the caribou in the DU winter and summer primarily at high elevations, so won't be impacted by logging. Those caribou in the Revelstoke area occur at all elevations and there has been less habitat protected there than what's recommended. Thus, the severity of logging to these caribou will be greater.
6	Human intrusions & disturbance	D	Low	Pervasive (71-100%)	Slight (1-10%)	High (Continuing)	
6.1	Recreational activities	D	Low	Pervasive (71-100%)	Slight (1-10%)	High (Continuing)	Threats include backcountry recreation (e.g., skiers, snowmobiliers) and low-flying helicopters (e.g., heli-skiing). This can lead to increased stress and displacement from ideal habitat (e.g., into avalanche prone terrain). Note: increased roads contribute to greater access for recreational users to caribou habitat. Severity: avalanches can be significant source of mortality for caribou (see section 10.3) and backcountry users directly increase this threat. Severity originally Slight, raised to Moderate, but lowered to Slight again, as 10% of mortality to caribou would be 180 animals over 10 years and it was felt that mortality would be less than this. A slight ranking also aligns with the other DU threats assessments.
6.2	War, civil unrest & military exercises		Negligible	Negligible (<1%)	Serious - Moderate (11-70%)	High (Continuing)	Scope: Mt. Revelstoke/Glacier military run avalanche control but scope likely negligible.
6.3	Work & other activities		Negligible	Large (31-70%)	Negligible (<1%)	High (Continuing)	General Comments: includes avalanche control, rock hounds, layout, and general traipsing around of workers prior to resource extraction activities. Severity: likely negligible (low certainty). 2/165 mortalities in Wittmer *et al.* 2005 were research (capture) related. Surveying does involve disturbing caribou with potential displacement to avalanche-prone terrain. There is a risk of direct mortality and displacement during avalanche control activities (e.g., highways - Kootenay Pass, Trans Canada Highway; heliskiing, mining, forestry).
7	Natural system modifications	D	Low	Pervasive (71-100%)	Slight (1-10%)	High (Continuing)	
7.1	Fire & fire suppression	D	Low	Small (1-10%)	Moderate - Slight (1-30%)	High (Continuing)	Some larger prescribed burns planned in National Parks. Some fires in Kootenay herds. Recognition that fires in the recent past have been a concern (large) in disturbing habitat in general and could affect future caribou habitat.
7.2	Dams & water management/use		Negligible	Small (1-10%)	Negligible (<1%)	High (Continuing)	Threat includes the impact of existing dams and new dams. Scope: small. Existing dams have resulted in a significant permanent loss of early winter habitat where they occured in caribou habitat. No new dams are expected in DU in next 10 years. Severity: there may be some decreased dispersal due to existing dams that is an ongoing threat, although caribou are known to swim the lake. Severity: negligible. Timing: high (continuing).

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
7.3	Other ecosystem modifications	D	Low	Pervasive (71-100%)	Slight (1-10%)	High (Continuing)	Threat includes changes in alternate prey populations (e.g., moose and deer) caused by current and future habitat change and forest pathogens (e.g., mountain pine beetle, spruce bark beetle) and the direct impact of this on caribou habitat and fitness. Scope: moose are decreasing, stable and increasing in different areas of DU, while deer are increasing in the south and likely throughout DU. KF: scope of impact of moose/deer is pervasive (i.e., all SM caribou likely to be impacted by recent impacts of development (logging, powerlines, etc.) via increased moose and deer populations even if all logging was stopped today. DB: may be worth considering to increase the scope to "large, 31-70%". Currently no overall plan to reduce moose population. Mountain pine beetle currently and in the next 10 years felt to be a small effect. Spruce bark beetles and other forest insects possible concern in future. Conditions will depend on the kind of management that is being done. Severity: hard to judge, may be less than serious since deer/moose don't directly kill or compete with caribou. But, the severe impact of altered predator prey dynamics due to increased early seral forest must be captured somewhere. This threat came up during different discussions on the call and was noted that it should be revisited (results of other ecosystem disturbance).
8	Invasive & other problematic species & genes	A	Very High	Pervasive (71-100%)	Extreme (71-100%)	High (Continuing)	
8.2	Problematic native species	A	Very High	Pervasive (71-100%)	Extreme (71-100%)	High (Continuing)	General Comments: threat considered was direct mortality due to predators (e.g., wolves, bear, cougar) and/or the influence they have on caribou (e.g., displacement, increased movement, stress, reduced body condition). However, increased predation was directly related to increased prey populations (e.g., moose, white tailed deer) following an increase in early seral forest due to considerable developement in the area (i.e., forest harvesting, mining, oil and gas activities). Recreational trails (e.g., ski/snomobile) also a contributing factor as they provide access for predators to caribou. Fire mostly a concern for herds in federal parks and Kootney area. Climate change a possible factor. Scope: pervasive. Severity: extreme (71-100). Concern that there are no large herds to dampen impact, as in DU7. Very few caribou will remain if this threat is not addressed in a timely and significant way.
10	Geological events	C	Medium	Large (31-70%)	Moderate (11-30%)	High (Continuing)	
10.3	Avalanches/landslides	C	Medium	Large (31-70%)	Moderate (11-30%)	High (Continuing)	Threat is posed by natural avalanches and not the increase in risk due to displacement of caribou into avalanche terrain from work or recreation, which are captured in those sections. Scope: avalanche risk is highest in steep and rugged terrain. Severity: avalanches pose a risk to all caribou, but particulary small populations.
11	Climate change & severe weather		Unknown	Pervasive (71-100%)	Unknown	High (Continuing)	
11.1	Habitat shifting & alteration		Unknown	Pervasive (71-100%)	Unknown	High (Continuing)	Climate change that will influence the entire DU is some way over the next 10 years. Severity: the severity of the change that will occur and its direct impact on caribou survival over 3 generations is uncertain/unknown. Climate modelling suggests that in perhaps 50 years the range of the Purcells-South caribou is likely to start contracting, with decreased snowpack, but increased winter rainfall, and spring snowfall projected to decrease much sooner by 2080. This will likely result in contraction of the duration or width of the snowpack barrier and change predation risk to caribou. Disease, fire or other disturbance agents may also start to convert forest habitat characteristics. Wang and others have models that predict the ICH vk may reduce significantly /

Threat		Impact (calculated)		Scope (next 10 Yrs)	Severity (10 Yrs or 3 Gen.)	Timing	Comments
							disappear or could shift up in elevation. Extreme weather conditions impact lichen, access to arboreal lichens, low snowfalls, and possible more frequent avalanche cycles.
11.3	Temperature extremes						This is captured in threat 11. 1.
11.4	Storms & flooding						This is captured in threat 11. 1.